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in this issue

Page

An Interregional Model: Its Formulation and Application to the Livestock Industry 1
G. G. Judge, J. Havlicek, and R. L. Rizek

Predicting the Beef Cattle Inventory . . . . . *Forrest Walters* 10

An Analysis of Intraseasonal Apple Price Movements 19
E. C. Pasour, Jr.

Book Reviews . . . . . *Harold F. Breimyer, Alvin C. Egbert, Gladys K. Bowles, Robert M. Walsh, John H. Southern, Melvin R. Janssen, Wayne D. Rasmussen* 31

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ERS announces the publication of a new bulletin by Dr. Frederick V. Waugh. It is "Demand and Price Analysis: Some Examples from Agriculture" (U.S. Dept. Agr., Tech. Bul. 1316, 94 pp., November 1964).

As the title suggests, the bulletin is about demand, prices, and returns for selected agricultural products. It should prove very interesting to outlook workers.

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An Interregional Model: Its Formulation and Application to the Livestock Industry

By G. G. Judge, J. Havlicek, and R. L. Rizek

IN THE FIRST PART of this paper, we are concerned with formulating an interregional activity analysis model for a multiproduct industry. The model is first presented as a generalization, applicable to many such industries. The remainder of the paper illustrates a specific application of the model to the livestock industry, showing how the model can be used to determine the optimum location of slaughter and the geographic flows of livestock and meat.[1]

Problem Specification

The general problem underlying the model formulation has the following characteristics: we are given in each of n regions a known nonnegative quantity of L types of primary and intermediate products for some time period t. Each primary and intermediate product passes through a processing plant and by this, production activity is converted to K final commodities ($K \gtreqless L$). The rate at which each primary and intermediate product may be transformed into each final consumable product is known for each region, product, and time period. A nonnegative quantity of each of the K final products is consumed in each of the n regions, and the regional consumption for each type of final product is assumed known for some time period t. Each region has some nonnegative capacity for processing each type of primary and intermediate product or, alternatively, the production of final commodities, and these capacities are known and fixed for any time period t. Each region has a unit processing cost for converting each type of primary and intermediate commodity into a final commodity, and these costs or cost differentials are known for time period t.

All commodities are assumed mobile and all possible pairs of regions are separated by a transportation cost per physical unit for each of the types of product and these transportation costs, for the shipment of each type of product, from region i to j are known for any time period t. It is further assumed that when the total regional supplies of primary and intermediate products are converted into final commodities the resulting total potential supply of each final commodity is equal to or greater than the total consumption. For processing and consumption purposes, each type of product is assumed homogeneous and thus processing firms and consumers are indifferent as to their source of supply. It is further assumed that all commodities are traded in competitive markets.

Given these specifications we wish to formulate a model which accounts for the interaction of the spatially separated economic units (supply of primary and intermediate products, processing and consumption of final products). In particular, given the above set of constraint specifications, we wish to formulate a model which can be used to ascertain the level and location of the processing of each type of primary and intermediate commodity and the volume and direction of all product flows that will minimize the aggregate transport and processing costs. We are thus seeking the allocation and pricing system which will maximize the returns to each source (supplier) and minimize the cost to consumers subject to the constraint conditions postulated for the multiregion industry.

[1] Some of the basic data used in this paper were developed in conjunction with the North Central Regional Livestock Marketing Project NCM-25.

The Model

NOTATION

As a basis for specifying the model in mathematical form let:

i,j denote the regions; $i,j = 1,2,\ldots,n$.

s_i^l denote the quantity of the lth type of primary or intermediate products available in region i (quantity available before inshipments and outshipments); $l = 1,2,\ldots L$.

d_i^k denote the demand for the kth type of final commodity in region i; $k = 1,2,\ldots,K$.

x_{ij}^l denote the quantity of the lth type of primary or intermediate product shipped from region i to j to be used in producing the kth final commodity.

x_{ij}^k denote the quantity of the kth type of final product shipped between regions i and j.

c_i^k denote the unit cost of processing the kth type of final commodity in region i.

t_{ij}^l denote the unit transport costs for a shipment of the lth type of primary or intermediate commodity from region i to j.

t_{ij}^k denote the unit transport cost for a shipment of the kth type of final commodity from region i to j.

α_i^{qm} denote the rate at which the qth type of product is converted per unit of process into the mth type of product in region i; $q = k,l,r$ and $m = k,l$.

s_i^r denote the capacity of the rth processing plant in region i.

g_i^q denote net availability (amount remaining after imports, exports, and use) in region i; $q = k,l,r$.

THE MATHEMATICAL MODEL

Given the foregoing restrictive and expository assumptions and using the above definitions and notation the constrained extremum problem may be expressed as: To maximize

$$(1) \qquad f(x) = -\sum_i\sum_j\sum_k t_{ij}^k x_{ij}^k - \sum_i\sum_j\sum_l t_{ij}^l x_{ij}^l - \sum_i\sum_j\sum_k c_i^k x_{ij}^k$$

$$= -\sum_i\sum_j\sum_k (t_{ij}^k + c_i^k) x_{ij}^k - \sum_i\sum_j\sum_l t_{ij}^l x_{ij}^l$$

subject to

$$(2) \qquad g_i^k = -d_i^k + \sum_j x_{ji}^k \geq 0$$

The shipment of the kth final commodity to region i from itself and other regions is equal to or greater than the demand in region i.

$$(3) \qquad g_i^l = s_i^l - \sum_j (x_{ij}^l - x_{ji}^l) - \sum_k \alpha_i^{lk} x_{ij}^k \geq 0$$

The quantity of the lth primary or intermediate product used in processing when producing the kth final commodity in the ith region, plus inshipment of the lth product into the ith region, minus outshipments of the lth product from the ith region, must be equal to or less than the native availability of the lth product in the ith region.

$$(4) \qquad g_i^r = s_i^r - \sum_k \alpha_i^{rk} x_{ij}^k \geq 0$$

The quantity of final commodities processed by the rth processing plant in region i is equal to or less than capacity.[2] And

$$(5) \qquad x_{ij}^l, x_{ij}^k \geq 0$$

All choice variables are constrained to be nonnegative.

To derive the necessary conditions for the maximization of (1), subject to the set of linear inequalities (2) through (5), let us set up the following Lagrangean:

$$(6) \qquad \phi(X,U) = f(X) + u^{q'} g^q$$

for (5) and

$$(7) \qquad u^q \geq 0 \quad \text{for} \quad q = k,l,r.$$

Denoting optimum values by bars and making use of the Kuhn-Tucker saddle point theorem

[2] The rth plant capacity in region i could of course be considered, in a more general context, in the class of immobile primary commodities.

(5),[3] the conditions for the maximum of (6) are as follows:

$$(8)\quad \partial\phi/\partial\bar{x}^k_{ij} = \bar{u}^k_j - \sum_l a^{lk}_i \bar{u}^l_i - \sum_r a^{rk}_i \bar{u}^r_i - (t^k_{ij} + c^k_i) \leq 0$$

$$\text{and } (\partial\phi/\partial\bar{x}^k_{ij})\bar{x}^k_{ij}) = 0$$

$$(9)\quad \partial\phi/\partial\bar{x}^l_{ij} = \bar{u}^l_j - \bar{u}^l_i - t^l_{ij} \leq 0 \text{ and } (\partial\phi/\partial\bar{x}^l_{ij})\bar{x}^l_{ij} = 0$$

$$(10)\quad \partial\phi/\partial\bar{u}^q_f = \bar{g}^q_f \geq 0 \text{ and } (\partial\phi/\partial\bar{u}^q_f)\bar{u}^q_i = 0.$$

If we follow the usual procedure of defining the Lagrangean in (6) as prices and rents, then conditions (8) through (10) spell out the characteristics of the internal price and rent system that are consistent with an efficient production and allocation program. In particular, these conditions state that in order to derive an efficient production and allocation program, regional values and rents must be such that:

(a) Profits are zero on all production and flow processes actually used and no process may show a positive profit (conditions (8) and (9)). For example, the first part of condition (9) states that the values (prices) for two regions can differ at most by the transport cost per unit. The second part of condition (9) states that flows only take place when this value differential is equal to the transport cost.

(b) Values of the primary and intermediate commodities may exceed zero only if their regional net availability ($\bar{g}^l$) is equal to zero (condition 10).

(c) Rents on processing plants and fixed demands may exceed zero only if the capacities in each case are fully utilized (condition 10).

The optimality conditions specified by (8), (9), and (10) are thus seen to yield values for the pricing and allocation problem that are consistent with the zero profit condition of competitive equilibrium.

If the system (1) through (5) is defined as the primal problem then the corresponding dual or counterpart of the production and flow solution is: To minimize

$$(11)\quad G = \sum_i d^k_i u^k_i - \sum_i s^r_i u^r_i - \sum_i s^l_i u^l_i$$

subject to the inequality system of (8) through (10), with $\bar{u}^q_i$ replaced by u^q_i and

$$(12)\quad u^q_i \geq 0$$

The general programming tableau consistent with the primal and dual formulation is given in table 1.

Table 1.--Interregional simplex tableau

Values and rents u	Equation number	Flow and processing activities: Final x^k_{ij}	Flow and processing activities: Primary and Intermediate $x^l_{ij}(i \neq j)$	Restrictions P_o
u^k_i	(2)	a^{kk}_i		d^k_i
u^l_i	(3)	a^{lk}_i	a^{ll}_i	$-s^l_i$
u^r_i	(4)	a^{rk}_i		$-s^r_i$
		$(t^k_{ij} + c^k_i)$	t^l_{ij}	
Equation number		(9)	(10)	

In an attempt to make the structure of the programming tableau completely clear, let us consider a problem consisting of two regions ($i = 1,2$), two final products ($k = 1,2$), two primary products each of which may be used in each final product ($l = 3,4$), and two multiproduct processing plants ($r = 5,6$) in each region. The tableau consistent with this problem is given in table 2.

Given these formulations, the simplex algorithm may be used to obtain the equilibrium value and allocation solution.

DISCUSSION OF THE MODEL

The model as formulated will handle a multiregion, multifinal product industry using intermediate or primary commodities as inputs in either single-product or multiproduct processing plants which have fixed capacities and are geographically distributed over n regions in some predetermined manner. The model could be extended to include the activities reflecting

[3] Underscored numbers in parentheses refer to items in the Literature Cited, p. 9.

Table 2.--Programming tableau for a simple problem

Internal prices and rents u	Equation number	Flow and production activities: Final x^1_{11}	x^1_{12}	x^1_{21}	x^1_{22}	x^2_{11}	x^2_{12}	x^2_{21}	x^2_{22}	Primary x^3_{12}	x^3_{21}	x^4_{12}	x^4_{21}	Restrictions	P_o
u^1_1	(2)	1		1											d^1_1
u^1_2			1		1										d^1_2
u^2_1						1		1							d^2_1
u^2_2							1		1						d^2_2
u^3_1	(3)	$-\alpha^{31}_1$	$-\alpha^{31}_1$			$-\alpha^{32}_1$	$-\alpha^{32}_1$			-1	1			$\geq$	$-s^3_1$
u^3_2				$-\alpha^{31}_2$	$-\alpha^{31}_2$			$-\alpha^{32}_2$	$-\alpha^{32}_2$	1	-1				$-s^3_2$
u^4_1		α^{41}_1	$-\alpha^{41}_1$			$-\alpha^{42}_1$	$-\alpha^{42}_1$					-1	1		$-s^4_1$
u^4_2				$-\alpha^{41}_2$	$-\alpha^{41}_2$			$-\alpha^{42}_2$	$-\alpha^{42}_2$			1	-1		$-s^4_2$
u^5_1	(4)	$-\alpha^{51}_1$	$-\alpha^{51}_1$			$-\alpha^{52}_1$	$-\alpha^{52}_1$								$-s^5_1$
u^5_2				$-\alpha^{51}_2$	$-\alpha^{51}_2$			$-\alpha^{52}_2$	$-\alpha^{52}_2$						$-s^5_2$
u^6_1		$-\alpha^{61}_1$	$-\alpha^{61}_1$			$-\alpha^{62}_1$	$-\alpha^{62}_1$								$-s^6_1$
u^6_2				$-\alpha^{61}_2$	$-\alpha^{61}_2$			$-\alpha^{62}_2$	$-\alpha^{62}_2$						$-s^6_2$
		c^1_1	c^1_1	c^1_2	c^1_2	c^2_1	c^2_1	c^2_2	c^2_2						
		+	+	+	+	+	+	+	+	t^3_{12}	t^3_{21}	t^4_{12}	t^4_{21}		
		t^1_{11}	t^1_{12}	t^1_{21}	t^1_{22}	t^2_{11}	t^2_{12}	t^2_{21}	t^2_{22}						

the production and flow of intermediate products. At the other extreme, it could be simplified to reflect only one final and intermediate product and type of processing plant. If processing costs (c^k_i) differed between regions, then the restrictions on plant capacity could be omitted and the model could be used to determine the ideal long-run level and location of processing activities. If the regional prices of final commodities are assumed to be known, then the same model could be employed with the modification that ($c^k_i + t^k_{ij}$) would be replaced by ($p^k_i - c^k_i - t^k_{ij}$) in the objective function. If desired restrictions could be specified for the flows of one or more commodities between regions, then the cost of this rigidity to resource owners could be assessed (this is the same type of rigidity as assuming plant location and capacity as given). In any event, the model as structured provides great flexibility in the set of specifications imposed and should be usable for a wide variety of applied problems concerned with spatial pricing and allocation.

An Empirical Analysis

For this analysis, the general model has been modified to handle the following problem: The U.S. economy has been partitioned into 26 regions which are identified in figures 1 and 2. The slaughter cattle-beef subsector of the livestock industry reflects the commodity space for the analysis. Calendar year 1955 is the time period considered. The estimated regional consumption of beef and the production of cattle for this time period are given in table 3. Each region is assumed to have processing facilities for converting slaughter cattle to beef. Estimated total regional capacities of these slaughtering plants are given in table 3. The rate at which cattle are converted to beef (α^{1k}_i) is assumed to be the same in each region, and this technical coefficient (dressing percentage) for 1955 is estimated at 0.551. The total regional supply of cattle when converted to beef is assumed to be equal to the total regional consumption

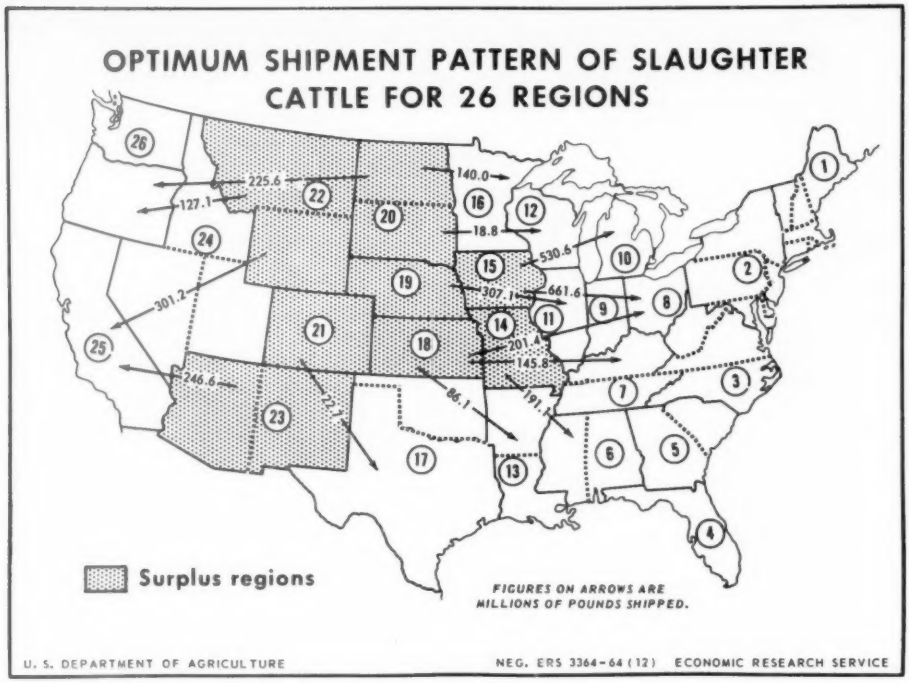

Figure 1

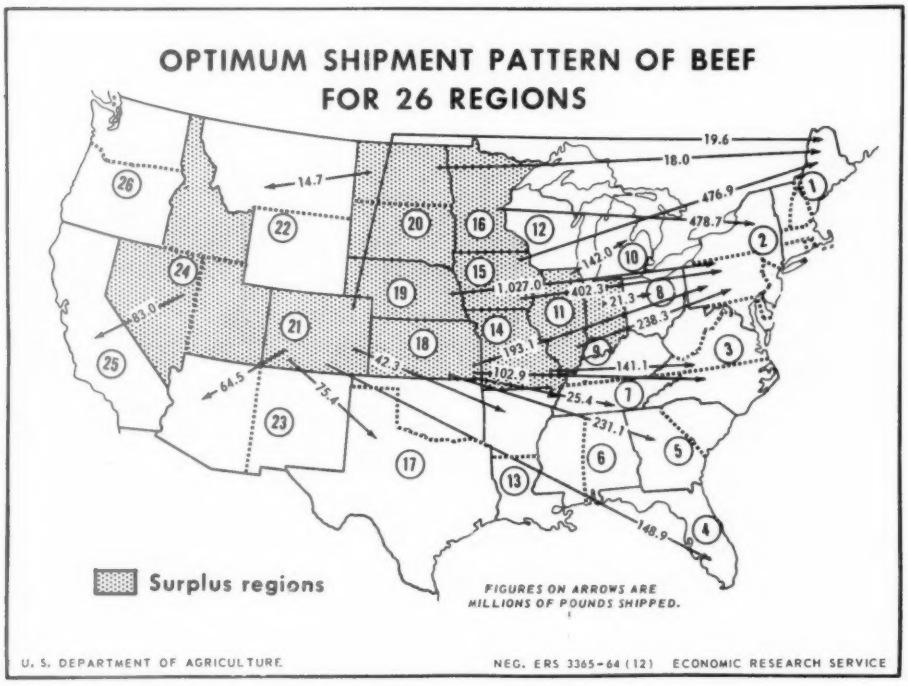

Figure 2

Table 3.--Regional estimates of slaughter cattle production, beef consumption, slaughter capacity, and costs, 1955

Region[1]	Slaughter cattle production (live weight)[2]	Beef consumption (dressed weight)[3]	Slaughtering capacity (live weight)[4]	Labor costs for slaughtering[4]
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Cents per 100 lb.*
1.....	185.0	781.5	426.3	22
2.....	908.5	2,840.0	2,786.3	22
3.....	477.8	507.3	727.8	16
4.....	128.7	219.8	476.5	15
5.....	159.2	318.8	797.3	18
6.....	302.3	271.9	572.9	15
7.....	413.2	333.4	937.7	21
8.....	616.6	836.5	1,661.4	22
9.....	760.5	397.8	834.8	24
10.....	435.9	674.6	966.6	23
11.....	1,938.5	857.0	2,723.9	25
12.....	569.5	324.2	906.4	25
13.....	304.5	257.5	390.5	14
14.....	1,156.3	390.7	1,187.9	24
15.....	3,192.3	222.9	2,000.3	24
16.....	1,227.1	274.5	1,466.7	28
17.....	1,849.7	1,107.0	3,094.3	20
18.....	1,768.3	183.1	1,335.0	23
19.....	2,376.3	113.2	2,069.2	25
20.....	934.4	105.3	550.0	24
21.....	943.1	156.6	920.4	23
22.....	565.3	90.2	137.0	20
23.....	457.9	180.9	211.2	18
24.....	444.0	161.7	504.9	22
25.....	1,659.8	1,299.2	2,632.9	26
26.....	426.1	429.1	1,036.6	24
Total.....	24,200.8	13,334.7	31,354.8	--

[1] The States in each region are shown in figures 1 and 2.
[2] For a discussion of the assumptions and procedures for developing these estimates see Havlicek, et al. (2).
[3] For a discussion of the development of these and alternative regional consumption estimates see Judge, et al. (3).
[4] For a discussion of the basis for these estimates see Rizek, et al. (8).

of beef. Thus equations (2) and (3) of the general model appear as equalities.

Regional slaughtering costs as reflected by differences in labor costs are given in table 3. Transport costs between each pair of regions have been estimated from transportation cost functions generated for both cattle and beef.[4]

[4] For the functions underlying these transport rates see (2) and (3).

Given these specifications and the set of basic data (restrictions), the objective of the modified model is to determine the level and location of slaughter and the volume and direction of slaughter cattle and beef flows that will minimize the aggregate transport and slaughtering costs for this subsector of the livestock industry. Consistent with the programming tableau of table 1, the problem as specified involves 72 equations and 1,326 activities.

THE RESULTS

The sets of interregional flows of slaughter cattle and beef consistent with the model and basic data previously specified are given in figures 1 and 2. The shaded areas in figure 1 reflect regions in which supplies of slaughter cattle exceeded slaughter capacity,[5] while the shaded areas of figure 2 represent regions in which the supply of slaughtered cattle (carcass beef) exceeds the demand for beef. The arrows indicate the direction of flows and the numbers within the line segments indicate the size of shipments.

Under the optimum solution, total slaughter cattle shipments were estimated at 3.2 billion pounds (13.2 percent of the total supply of slaughter cattle), with an accompanying transportation bill of $32.4 million. Of the 8 regions shipping to other regions, Iowa had the largest excess supply of slaughter cattle (1.2 billion pounds). In most cases, slaughter cattle from the surplus regions were shipped to the closest region with excess slaughter capacity, because net transportation costs are higher for slaughter cattle than for carcass beef. Thus, for example, the regions on the East Coast did not receive any shipments and slaughtered only their own production.

Under the optimum solution 4.1 billion pounds (slightly over 30 percent of the total beef supply) of carcass beef moved in interregional trade at a corresponding total cost of $100.8 million. The dominant surplus areas of carcass beef were the Corn Belt and Northern Plain States, while the East Coast was the dominant deficit area.

The optimum level of regional slaughter generated by the analysis is given in table 4. In comparison with actual slaughter (also given in table 4) under the optimum solution, 19 regions would have increased their slaughter. In region 2 (New York, Pennsylvania, New Jersey, Delaware, Maryland) the optimum level of slaughter was 1.3 billion pounds less than the amount of actual slaughter. In only nine regions was all of the slaughtering capacity used (table 4).

[5] An exception to this identification is the region represented by the State of Missouri, which exported cattle although slaughter capacity was not fully utilized.

Internal prices consistent with the optimum flow patterns and regional livestock slaughter are given in table 4. The differential regional values for carcass beef are derived relative to Colorado as the base region. These values indicate the comparative price advantage which surplus regions have relative to Colorado and the delivered price differentials which deficit regions have relative to the base region. These results indicate, for example, that carcass beef is worth $1.69 more per 100 pounds in Illinois than in Colorado because of its proximity to the deficit regions of the East. Alternatively, carcass beef is worth $2.16 more in deficit New England than in Illinois.

The optimal regional values of slaughter cattle given in table 4 are specified so as to be consistent with conditions (8) and (9) and the regional values for carcass beef. Table 4 shows that the surplus regions with the greatest comparative price disadvantage are North and South Dakota, Montana, Wyoming, and Colorado. The value of slaughter cattle was highest in the Northeast.

In 9 of the 26 regions, slaughter capacity was completely utilized. Therefore, consistent with condition (10), a rent may accrue to the plants in these locations. The internal rents consistent with the price and allocation solution are also given in table 4. These rents, which are a function of both location and quality (costs), varied from a low of 4 cents per 100 pounds of slaughter cattle in Michigan to a high of $1.05 per 100 pounds in Montana and Wyoming. One reason for the high rent accruing in Montana and Wyoming is that slaughter capacity is so restrictive that this region must export cattle and then import carcass beef. The rents that accrue to regions where capacity is exhausted give an indication of the relative profitability of increasing slaughter capacity in each of the particular regions.

IMPLICATIONS OF THE RESULTS

The results of the analysis for slaughter cattle and beef reflect the fact that slaughtering plants will probably continue to be located at the points of production, and that under the cost structures considered, the dominant producing

Table 4.--Regional estimates of the optimal level of cattle slaughter, price differentials, and rents, and actual cattle slaughter, 1955

Region	Actual (live weight)[1]		Optimally determined				
	Slaughter	Estimated excess capacity	Slaughter	Excess capacity	Price differential per 100 lb.		Rent per 100 lb. (live basis)
					Carcass weight	Live weight	
	Mil. lb.	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Dollars*	*Dollars*	*Dollars*
1.....	261.9	164.4	185.0	241.3	3.85	1.90	
2.....	2,190.3	596.0	908.5	1,877.8	3.45	1.68	
3.....	346.8	381.0	477.8	250.0	3.40	1.71	
4.....	303.1	173.4	128.7	347.8	3.66	1.87	
5.....	438.3	359.0	159.2	638.1	2.86	1.40	
6.....	296.7	276.2	493.4	79.5	2.50	1.23	
7.....	616.1	321.6	559.0	378.7	2.37	1.10	
8.....	1,104.8	556.6	1,479.5	181.9	2.52	1.17	
9.....	652.7	182.1	760.5	74.2	1.96	.84	
10.....	795.0	171.6	966.6	0	2.52	1.12	0.04
11.....	2,034.7	689.2	2,245.6	478.3	1.69	.68	
12.....	870.0	36.4	588.3	318.1	1.73	.70	
13.....	246.4	144.1	390.5	0	2.39	1.04	.14
14.....	951.5	236.4	965.2	222.7	1.24	.44	
15.....	1,912.4	87.9	2,000.3	0	1.05	.21	.13
16.....	1,471.5	- 4.8	1,367.1	99.7	.95	.24	
17.....	1,719.3	1,375.1	1,872.4	1,222.0	1.76	.77	
18.....	1,143.8	191.2	1,335.0	0	1.00	.15	.17
19.....	1,880.1	189.1	2,069.2	0	.79	-.08	.27
20.....	467.6	82.4	550.0	0	.23	-.49	.38
21.....	851.6	68.8	920.4	0	0	-.26	.03
22.....	88.2	48.8	137.0	0	1.37	-.50	1.05
23.....	143.5	67.7	211.2	0	1.88	.02	.84
24.....	318.1	186.8	444.0	60.9	.35	-.03	
25.....	2,415.7	217.1	2,207.6	425.2	2.28	1.00	
26.....	680.7	355.9	778.8	257.8	2.01	.87	
Total.....	24,200.8	7,154.0	24,200.8	7,154.0	--	--	--

[1] For a discussion of the development of these data see Rizek, et al. (8).

regions will continue to slaughter at or near capacity levels, even though slaughtering costs are lower in other regions such as the Southeast. A factor not considered in this analysis, which would tend to strengthen this conclusion, is that plants in the Corn Belt and other dominant producing regions tend to have larger rated capacities because of the high density of livestock production. In view of the economies of scale depicted by Logan and King (6) and others, the regional differentials in labor slaughtering costs would be reduced between the Corn Belt and regions in the Southeast, thus giving further emphasis to slaughtering at the point of production.

The results of the analysis substantiate the conclusion of considerable excess slaughter capacity in the meat packing industry. The estimates of optimal level and location of slaughter indicate that the major portion of the excess slaughter capacity exists in the regions on the East and West Coasts. The estimated rents that accrue in the regions where slaughter capacity is completely utilized give a measure of the economic incentive for expanding plant capacity in these regions, and the estimates of opportunity costs that result for regions where slaughter capacity is not completely utilized indicate how much transportation costs or slaughtering costs would have to be reduced before these regions would increase their level of slaughter. The structure of the model and the results of the analysis point up the great need for accurate projections on regional production and consumption in reaching decisions about future changes in the location and capacity of livestock slaughter facilities.

CONCLUDING REMARKS

A general multiregion, multiproduct model has been proposed and used for the analysis

of the price, production, and allocation efficiency of a sector or subsector of the economy under given or postulated conditions. The model is operational, and for the study reported in this article, which involved 72 equations and 1,326 activities, less than 2 minutes of computing time was needed on the IBM 7094 electronic computer. Alternative models have been proposed by King (4) and Rhody[6] as a basis for analyzing problems of determining the processing and final and primary commodity flows simultaneously. However, the transshipment model (7) proposed by King, and the method of reduced matrices (1) proposed by Rhody, handle problems involving only one primary and final commodity. Thus the transshipment and reduced matrices models are too restrictive for many problems which need to consider a multiproduct commodity space and multiproduct processing plants. Since modern computers have the capacity to handle programming problems involving over 1,000 equations and an almost unlimited number of activities, it would appear that the great flexibility inherent in the specifications for the model proposed in this paper would make it applicable to a wide variety of significant problems. Because production, processing, distribution, and consumption can be considered simultaneously, this model should make it possible to add greater realism to specifications and to improve the accuracy and usefulness of interregional research.

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Predicting the Beef Cattle Inventory

By Forrest Walters

THE NUMBER of beef cattle which beef producers plan to keep on farms is due largely to the prices they expect to receive for feeder calves or slaughter animals. In this paper simple relationships between cattle numbers and past prices are constructed to embody the latest price information available for estimating beef cattle numbers from 6 months to more than a year in advance.[1] The relationships have been deliberately kept simple so that they can be used conveniently. In addition to prices used in these relationships, many other events must be examined by the forecaster to see whether they will influence the decision to keep more or fewer cattle on farms.

The Beef Inventory Cycle

The beef cattle industry in the past has been subject to costly cyclical movements. The industry seems to be seized periodically with "spontaneous optimism." During these periods, usually following favorable prices, the growth rate of cattle numbers exceeds an equilibrium growth rate. Cattle numbers in the optimistic periods are increased by adding cows to the basic breeding herds and by keeping feeder cattle longer than usual, consequently to heavier weights. This increasing production finally exceeds the increasing demand, causing first slaughter prices and then feeder prices to decrease.

With the advent of lower prices the industry becomes subject to a kind of "simultaneous pessimism." The pessimistic cattle producers then reduce the size of their basic breeding herds (because they are less profitable) by selling cows from these herds for slaughter and not replacing them with heifers. This adds even more to total production and further lowers slaughter prices. Feeders retain the cattle that they are feeding in hopes of better prices. However, after it becomes apparent that prices have stabilized at the lower levels the fed-cattle producers must then sell their cattle at heavier weights than usual. These cattle are heavier because they have been retained for a longer time on a concentrate ration. Again this adds to the already towering production.

The cattle industry has been subject to three separate cycles since 1929. Each successive cycle has required a shorter liquidation period. The cycle which began with 1929 took 6 years to build up the inventory. After 1934 it required 5 years to deplete this inventory and begin a new cycle in 1940. The new cycle took 6 years for the inventory to build up to such a position that it was necessary to liquidate. The liquidation period which began with 1946 required only 3 years. The most recent cycle which we can observe began with 1949 and took 8 years to accumulate an inventory that depressed prices and resulted in liquidation. However, the liquidation phase lasted only 2 years. We are on our sixth year of accumulation in the present cycle which began with 1959. Will we continue to adjust or to liquidate over short periods of time, or can herds continue to increase over a long period of time without a destructive liquidation phase of the cycle occurring? These cycles can be observed in figure 1.

Classes of the Inventory

The inventory of beef cattle is divided into four classes: cows and heifers 2 years and older; heifers 1 to 2 years old and steers 1 year and older; calves and bulls 1 year and older. This inventory, often called "other" cattle, is shown in table 1. The total beef cattle inventory is, of course, the summation of each of these segments of the inventory.

This study uses separate relations to estimate each class of the inventory 6 and 12 months in

[1]The author is grateful to Anthony S. Rojko of ERS for helping with the forecasts made more than a year in advance, and to R. L. Rizek, Don Seaborg, and George R. Rockwell, Jr., for their suggestions and for making data available.

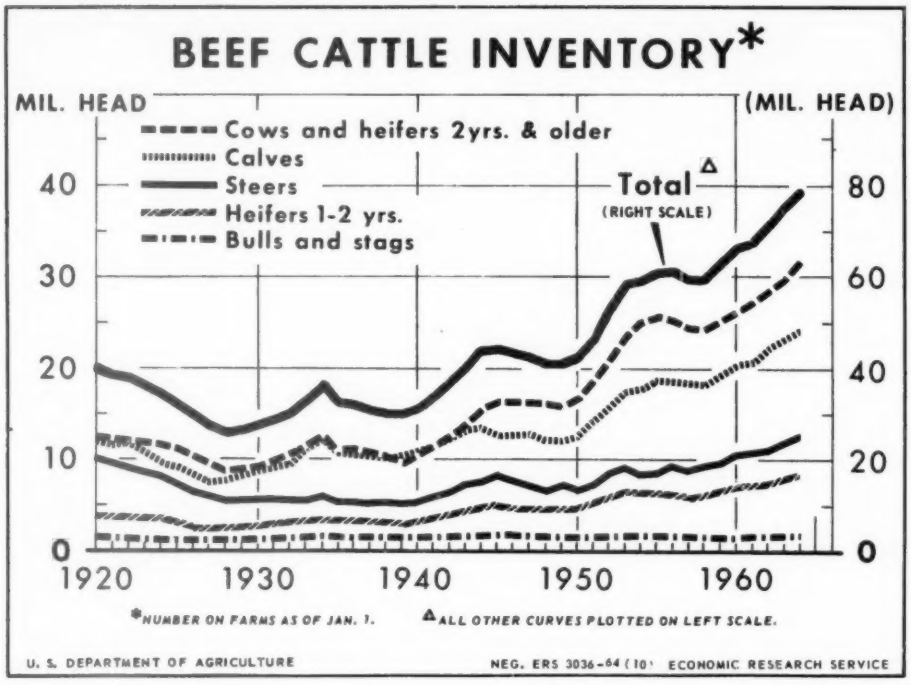


Figure 1

Table 1.--Beef cattle and calves on farms, January 1, 1947-64

Year	Heifers 1-2 years old and steers 1 year and older	Calves	Bulls 1 year and older	Cows and heifers 2 years and older	Total
	1,000 head	*1,000 head*	*1,000 head*	*1,000 head*	*1,000 head*
1947..	11,745	12,804	1,834	16,488	42,871
1948..	11,190	12,046	1,756	16,010	41,002
1949..	11,927	12,033	1,681	15,919	41,560
1950..	11,559	12,516	1,690	16,743	42,508
1951..	12,151	14,319	1,689	18,526	46,685
1952..	14,371	15,829	1,774	20,863	52,837
1953..	15,682	17,440	1,907	23,291	58,320
1954..	14,594	17,978	1,896	25,050	59,518
1955..	14,958	18,804	1,829	25,659	61,250
1956..	15,689	18,869	1,762	25,371	61,691
1957..	14,017	18,405	1,713	24,534	59,569
1958..	15,155	18,275	1,619	24,165	59,214
1959..	16,488	19,407	1,607	25,112	62,614
1960..	17,610	20,425	1,676	26,344	66,055
1961..	18,046	20,705	1,707	27,102	67,560
1962..	18,393	22,050	1,704	28,305	70,452
1963..	20,038	23,330	1,747	29,970	75,085
1964..	20,826	24,417	1,812	31,779	78,834

Source: Listed as "Other Cattle & Calves" in Livestock and Meat Statistics, U.S. Dept. Agr., Statis. Bul. 333, p. 4, July 1963.

advance. These individual estimates are then combined to form an estimate of the total inventory. Simple relationships between prices of slaughter cattle, prices of feeder cattle, and cattle numbers are used to make these estimates, recognizing that more complex relationships could have been established. The variables used in these relations are as follows:

The Dependent Variables

I_t = Total number of beef (other) cattle on farms January 1, in millions of head.

C_t = Total number of beef cows and heifers 2 years and older on farms January 1, in millions of head.

V_t = Total number of beef calves on farms January 1, in millions of head.

B_t = Total number of beef bulls 1 year and older on farms January 1, in millions of head.

Y_t = Total beef heifers 1 to 2 years old and beef steers 1 year and older, in millions of head.

The Independent Variables

$P_{1,t-6}$ = Average price of Choice and Good feeder calves at Kansas City from July through June of the previous year in dollars per hundredweight.

$P_{1,t-12}$ = Average price of Choice and Good feeder calves at Kansas City for the previous calendar year in dollars per hundredweight.

$P_{1,t-18}$ = Same as $P_{1,t-6}$ but 1 year earlier.

$P_{2,t-6}$ = Average price of Choice slaughter steers at Chicago from July through June of the previous year in dollars per hundredweight.

$P_{2,t-12}$ = Average price of Choice slaughter steers at Chicago for the previous calendar year in dollars per hundredweight.

$P_{2,t-18}$ = Same as $P_{2,t-6}$ but 1 year earlier.

$P_{3,t-6}$ = Average price of No. 2 corn at Chicago from July through June of the previous year in dollars per hundredweight.

$P_{3,t-12}$ = Average price of No. 2 corn at Chicago for the calendar year in dollars per hundredweight.

$P_{3,t-18}$ = Same as $P_{3,t-6}$ but 1 year earlier.

C_{t-12} = Total number of beef cows and heifers 2 years and older on farms January 1, the previous year, in millions of head.

V_{t-12} = Total number of beef calves on farms January 1, the previous year, in millions of head.

Five equations are used to show the relationship between the unknowns and the independent variables. The five unknowns are linked in inventory equation (1).

$$(1) \qquad I_t = C_t + V_t + B_t + Y_t$$

THE COW INVENTORY

Income from beef cows can be derived from two sources. The cows may be sold for slaughter to produce an immediate income or they may be kept in the breeding herds to produce calves. Income to this investment in calf production is measured by the value of the calves. Each year the beef calf producer must decide whether to receive the immediate income from selling cows for slaughter or to keep them for the income received from producing calves. This decision, of course, depends primarily on the expected price or value of calves. If the expected income from producing calves is sufficient to induce the producer to retain his investment in breeding stock then the cows are kept during another production period. The price of feeder calves was used to represent income from producing calves and the specified relationship is equation (2).

$$(2) \qquad C'_t = a_1 + b_1 C_{t-12} + b_2 P_{1,t-6} + b_3 P_{1,t-18}$$

C' is the estimated value of C. The estimated and observed values of C with the data necessary for estimating C are shown in figure 2.

If producers decide to reduce the number of beef cows kept on farms for breeding purposes, they can do so immediately. They can increase the normal culling rate or reduce the number of heifer replacements. The most recent price information ($P_{1,t-6}$) is used as an indicator of these immediate adjustments in herd size.

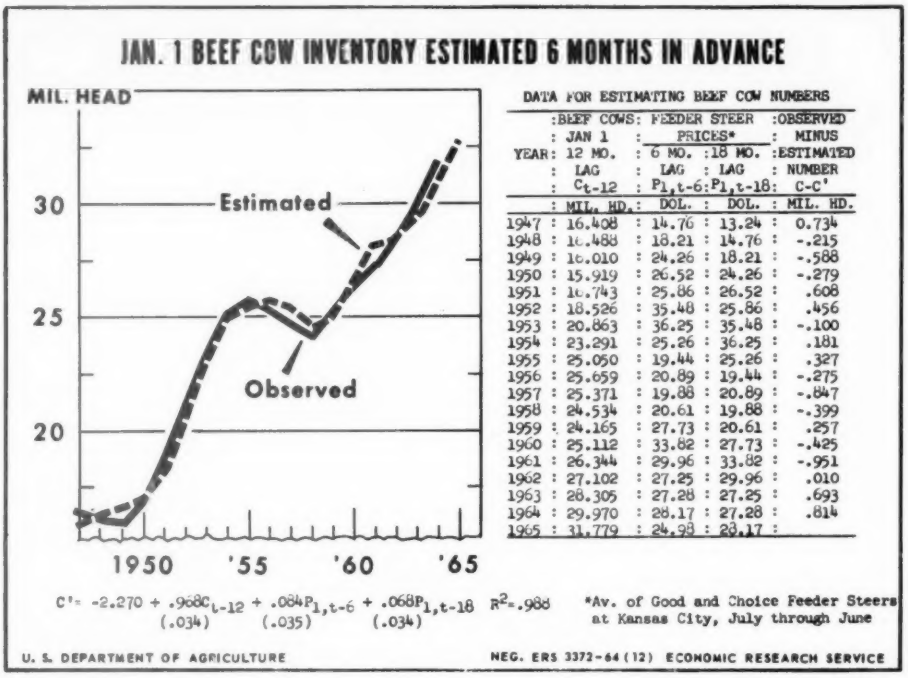
However, the number cannot be increased without planning and without a time lapse beforehand. Although the beef cow herd can be increased somewhat by adding 2-year-old heifers and reducing the culling rate, the usual practice is to keep 6-month-old heifer calves rather than selling them to feedlots. It is fully 18 months before these heifer calves can be included in the numbers of beef cows 2 years and older. This increase in calves is not reflected in the cow inventory, C_{t-1}. For this reason, if current prices are expected prices, the price $P_{1,t-18}$ must be used to explain increases in C_t.

One of the undesirable features of equation (2) is that it provides estimates only 6 months in advance. Of more interest would be an equation which would give estimates of an event at least a year in advance. One such relationship could be equation (2) with $P_{1,t-6}$ removed. For example:

$$(3) \qquad C'_t = a_2 + b_4 C'_{t-12} + b_5 P_{1,t-18}$$

where C'_{t-12} would be estimated by equation (2). Another alternative would be

$$(4) \qquad C'_t = a_2 + b_4 C'_{t-12} + b_5 P_{1,t-12}$$



DATA FOR ESTIMATING BEEF COW NUMBERS

YEAR	BEEF COWS: JAN 1 12 MO. LAG C_{t-12}	FEEDER STEER PRICES*: 6 MO. LAG $P_{1,t-6}$	FEEDER STEER PRICES*: 18 MO. LAG $P_{1,t-18}$	OBSERVED MINUS ESTIMATED NUMBER C-C'
	MIL. HD.	DOL.	DOL.	MIL. HD.
1947	16.408	14.76	13.24	0.734
1948	16.488	18.21	14.76	-.215
1949	16.010	24.26	18.21	-.588
1950	15.919	26.52	24.26	-.279
1951	16.743	25.86	26.52	.608
1952	18.526	35.48	25.86	.456
1953	20.863	36.25	35.48	-.100
1954	23.291	25.26	36.25	.181
1955	25.050	19.44	25.26	.327
1956	25.659	20.89	19.44	-.275
1957	25.371	19.88	20.89	-.847
1958	24.534	20.61	19.88	-.399
1959	24.165	27.73	20.61	.257
1960	25.112	33.82	27.73	-.425
1961	26.344	29.96	33.82	-.951
1962	27.102	27.25	29.96	.010
1963	28.305	27.28	27.25	.693
1964	29.970	28.17	27.28	.814
1965	31.779	24.98	28.17	

Figure 2

Use of equation (4) would require a partial forecast of the price variable if the forecast is made before data for the calendar year are available.

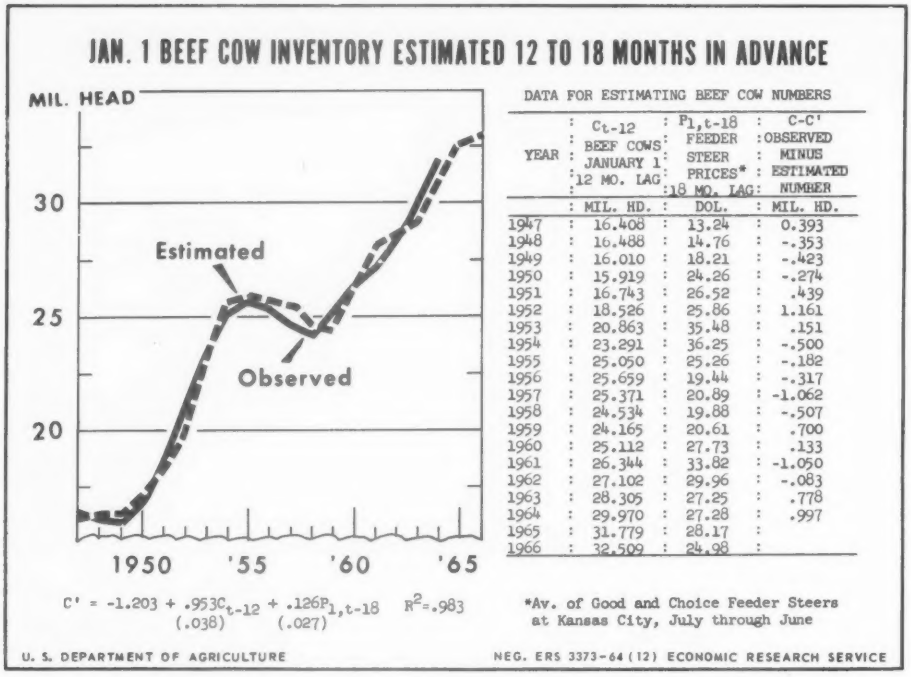
The conditional forecast for beef cow numbers on January 1, 1965, using equation (2) is 32.5 million head (see fig. 2). The forecasts for 1966 are 32.9 million head using equation (3) and 32.7 million using equation (4). Figures 3 and 4 illustrate forecasts made from this equation.

There are many other events or factors besides price of feeder calves which should be watched closely between the time that these estimates of cow numbers are made and the time that the cow numbers are observed; for example, the ecological balance of plant and animal life in the range areas. This balance certainly has an effect on the numbers of cows producers are able to keep on pastures or ranges for breeding purpose. Western range and cattle conditions in 1963 and to date in 1964 have not been as good as they were from 1958 through 1962. When range conditions have been bad for several years, the cost of feeding cows through the winter increases because of the additional roughage needed.

In addition, the most recent prices of feeder calves should be observed. For example, the average feeder calf price of $24.98 from July 1963 through June 1964 declined to an average of $21.58 in July, August, and September.

THE CALF INVENTORY

The calf inventory as of January 1 cannot exceed the number of calves born during the preceding year. The number of calves born during the year depends on the fertility rate (number of calves born per 100 cows). This rate has remained at 86 calves per 100 cows since 1958. The number of these calves that remain on farms January 1 the following year has also remained rather stable at around 77 calves per 100 cows since 1958. This, of course, may fluctuate occasionally depending on when most of the calves are born during the year and the number of dairy calves kept for feeding purposes. The stable relationship between beef

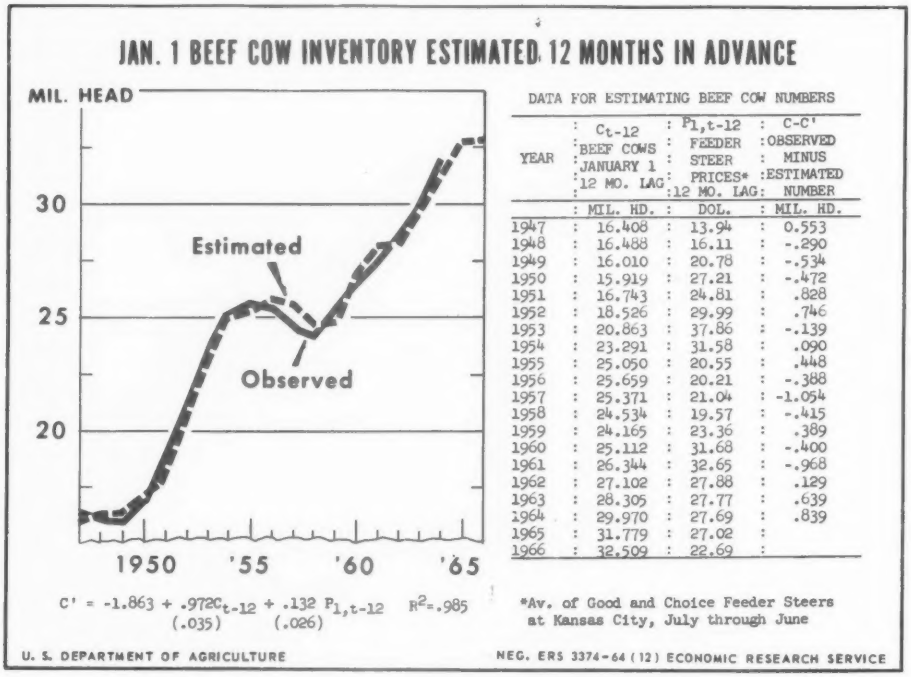


DATA FOR ESTIMATING BEEF COW NUMBERS

YEAR	C_{t-12} BEEF COWS JANUARY 1 12 MO. LAG	$P_{1,t-18}$ FEEDER STEER PRICES* 18 MO. LAG	C-C' OBSERVED MINUS ESTIMATED NUMBER
	MIL. HD.	DOL.	MIL. HD.
1947	16.408	13.24	0.393
1948	16.488	14.76	-.353
1949	16.010	18.21	-.423
1950	15.919	24.26	-.274
1951	16.743	26.52	.439
1952	18.526	25.86	1.161
1953	20.863	35.48	.151
1954	23.291	36.25	-.500
1955	25.050	25.26	-.182
1956	25.659	19.44	-.317
1957	25.371	20.89	-1.062
1958	24.534	19.88	-.507
1959	24.165	20.61	.700
1960	25.112	27.73	.133
1961	26.344	33.82	-1.050
1962	27.102	29.96	-.083
1963	28.305	27.25	.778
1964	29.970	27.28	.997
1965	31.779	28.17	
1966	32.509	24.98	

*Av. of Good and Choice Feeder Steers at Kansas City, July through June

Figure 3



DATA FOR ESTIMATING BEEF COW NUMBERS

YEAR	C_{t-12} BEEF COWS JANUARY 1 12 MO. LAG	$P_{1,t-12}$ FEEDER STEER PRICES* 12 MO. LAG	C-C' OBSERVED MINUS ESTIMATED NUMBER
	MIL. HD.	DOL.	MIL. HD.
1947	16.408	13.94	0.553
1948	16.488	16.11	-.290
1949	16.010	20.78	-.534
1950	15.919	27.21	-.472
1951	16.743	24.81	.828
1952	18.526	29.99	.746
1953	20.863	37.86	-.139
1954	23.291	31.58	.090
1955	25.050	20.55	.448
1956	25.659	20.21	-.388
1957	25.371	21.04	-1.054
1958	24.534	19.57	-.415
1959	24.165	23.36	.389
1960	25.112	31.68	-.400
1961	26.344	32.65	-.968
1962	27.102	27.88	.129
1963	28.305	27.77	.639
1964	29.970	27.69	.839
1965	31.779	27.02	
1966	32.509	22.69	

*Av. of Good and Choice Feeder Steers at Kansas City, July through June

Figure 4

cows kept on farms January 1 and beef calves kept on farms January 1 is specified as follows:

(5) $$V = \alpha C$$

where α is estimated as $\frac{V_{t-12}}{C_{t-12}}$.

THE BULL INVENTORY

The number of beef bulls kept on farms is again dependent on the number of beef cows kept in breeding herds. The observed number per 100 cows changes as the average size of breeding herds changes and as new techniques such as artificial insemination are adopted. The number of beef bulls per 100 beef cows has gradually drifted downward from about 10 in 1948 to about 5-1/2 this year. The relationship between beef bulls and cows is:

(6) $$B = \beta C,$$

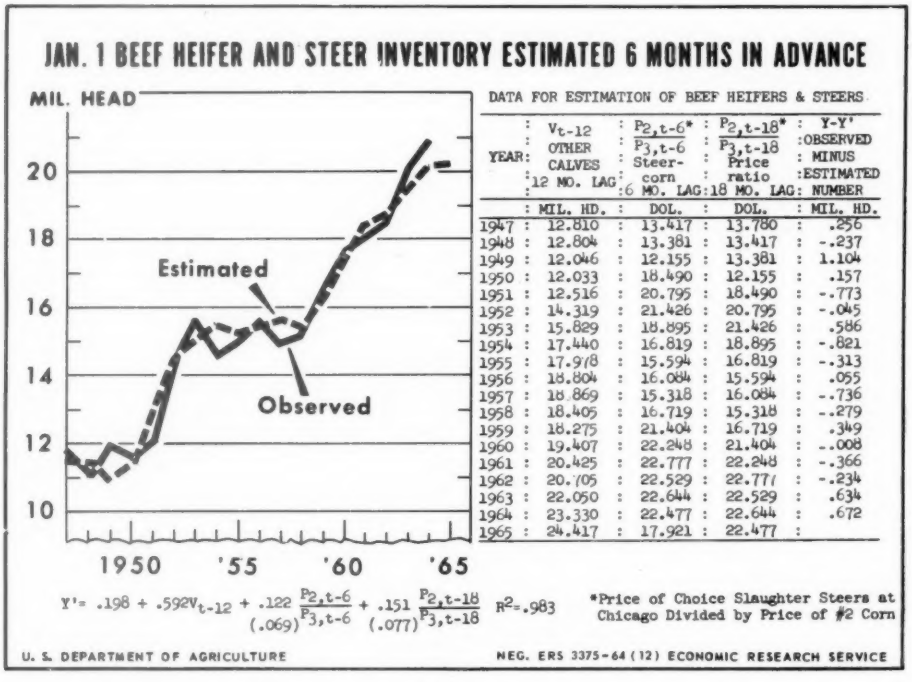
where β is estimated by $\frac{B_{t-12}}{C_{t-12}}$.

THE BEEF STEER AND HEIFER INVENTORY

The number of calves on farms January 1 serves as a pool from which the inventory of heifers 1 to 2 years old and steers 1 year and older is drawn the following year. The number drawn from this pool and kept rather than slaughtered depends on the expected returns from slaughtering these calves at a later date, compared to the expected costs of keeping them. Many of these cattle are sold as fed cattle and for this reason fed-cattle prices would indicate the expected returns. Expected costs would depend on feed prices. The relationship between the number of beef steers and heifers kept on farms January 1, beef calf numbers, fed-cattle prices, and feed prices is:

(7) $$Y_t = a_3 + b_6 V_{t-12} + b_7 \frac{P_{2,t-6}}{P_{3,t-6}} + b_8 \frac{P_{2,t-18}}{P_{3,t-18}}.$$

This fitted relationship, the estimated values of Y, and the observed values of Y are shown in figure 5.



DATA FOR ESTIMATION OF BEEF HEIFERS & STEERS

YEAR	V_{t-12} OTHER CALVES 12 MO. LAG	$P_{2,t-6}/P_{3,t-6}$* Steer-corn 6 MO. LAG	$P_{2,t-18}/P_{3,t-18}$* Price ratio 18 MO. LAG	Y-Y' OBSERVED MINUS ESTIMATED NUMBER
	MIL. HD.	DOL.	DOL.	MIL. HD.
1947	12.810	13.417	13.780	.256
1948	12.804	13.381	13.417	-.237
1949	12.046	12.155	13.381	1.104
1950	12.033	18.490	12.155	.157
1951	12.516	20.795	18.490	-.773
1952	14.319	21.426	20.795	-.045
1953	15.829	18.895	21.426	.586
1954	17.440	16.819	18.895	-.821
1955	17.978	15.594	16.819	-.313
1956	18.804	16.084	15.594	.055
1957	18.869	15.318	16.084	-.736
1958	18.405	16.719	15.318	-.279
1959	18.275	21.404	16.719	.349
1960	19.407	22.248	21.404	-.008
1961	20.425	22.777	22.248	-.366
1962	20.705	22.529	22.777	-.234
1963	22.050	22.644	22.529	.634
1964	23.330	22.477	22.644	.672
1965	24.417	17.921	22.477	

Figure 5

Income from feeding cattle comes from two sources: income due to the difference in the price of the feeder calf and the price of the fed animal, and income due to feeding or the weight gained by the animal on feed. The expected sum of these two incomes per head would determine whether feeders are willing to invest in more or fewer numbers of feeder cattle. Since the price of slaughter cattle relative to the price of corn is an indicator of these incomes, these prices can be used to indicate expected income to the feeder. Each time the fed cattle producer reinvests in feeder calves, which he does at least every 18 months, it is necessary for him to determine his expected income from this new investment.

In addition to this relationship another equation was specified in order to use the latest price information available in estimating steer and heifer numbers 1 year in advance. The fitted relationship is shown in figure 6. This relationship is

$$(8) \qquad Y_t = a_4 + b_9 V_{t-12} + b_{10} \frac{P_{2,t-12}}{P_{3,t-12}}.$$

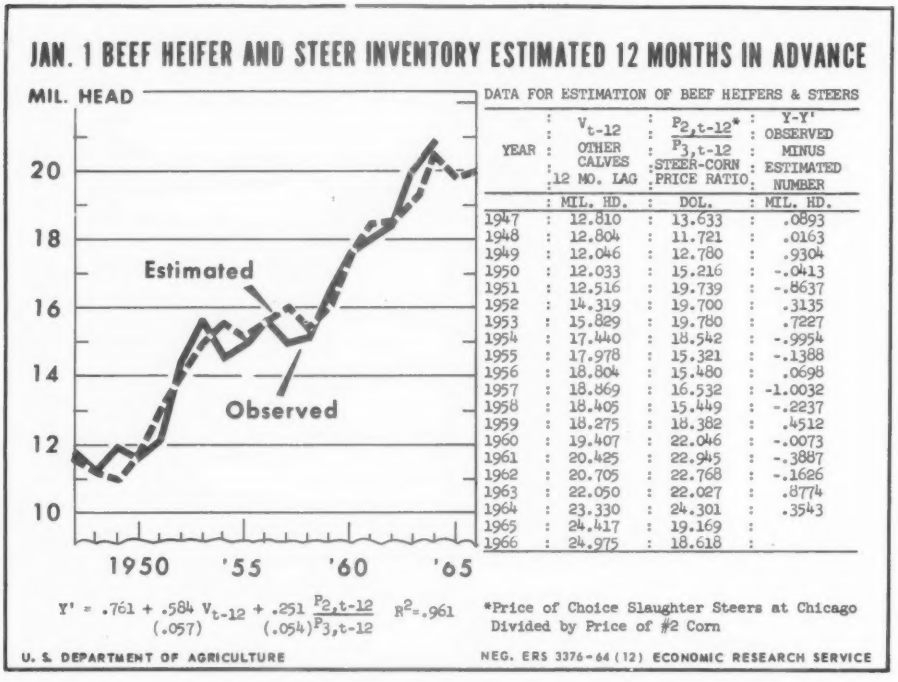
THE TOTAL INVENTORY

The total inventory results from the summation of all the classes within the inventory. Since all the independent variables in the equations are lagged by at least 6 months, conditional expectations for the number in each class may be computed 6 months and 18 months before January 1. The relationships summed to estimate the total inventory may be written as follows:

$$(9) \qquad I'_t = C'_t \left(1 + \frac{V_{t-12} + B_{t-12}}{C_{t-12}}\right) + Y'_t.$$

The values of estimated I and observed I are recorded in figure 7. The estimated values of I_t for 1966 result from using equations (3) or (4) and (8). The other estimated values of I_t (from 1947 through 1965) result from using equations (2) and (7).

Since these estimates are based on past prices and do not always take into account some of the intangible factors it is interesting to compare the estimates for the total inventory here with

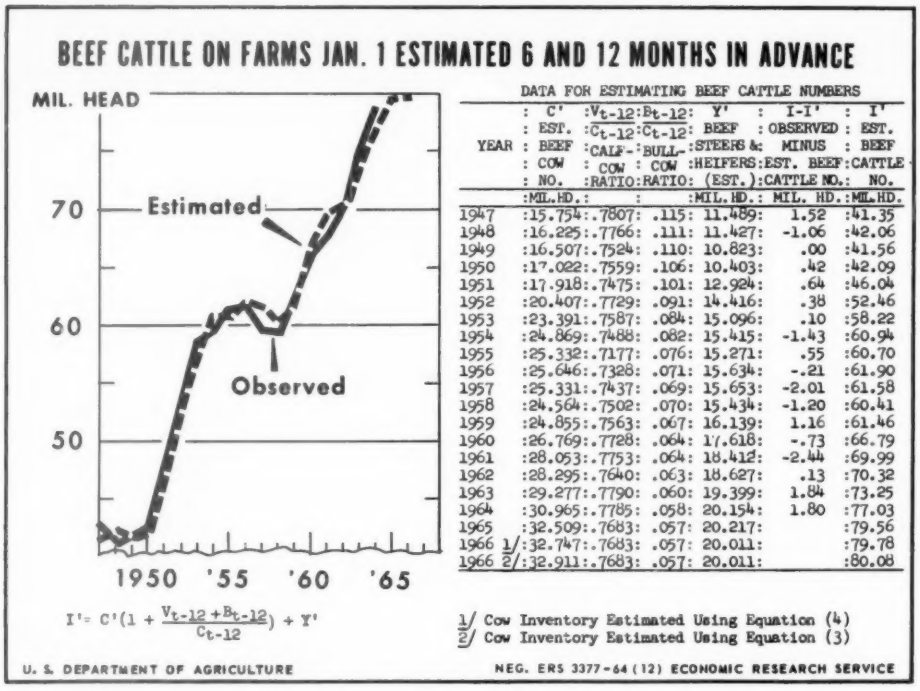


DATA FOR ESTIMATION OF BEEF HEIFERS & STEERS

YEAR	V_{t-12} OTHER CALVES 12 MO. LAG	$P_{2,t-12}/P_{3,t-12}$* STEER-CORN PRICE RATIO	Y-Y' OBSERVED MINUS ESTIMATED NUMBER
	MIL. HD.	DOL.	MIL. HD.
1947	12.810	13.633	.0893
1948	12.804	11.721	.0163
1949	12.046	12.780	.9304
1950	12.033	15.216	-.0413
1951	12.516	19.739	-.8637
1952	14.319	19.700	.3135
1953	15.829	19.780	.7227
1954	17.440	18.542	-.9954
1955	17.978	15.321	-.1388
1956	18.804	15.480	.0698
1957	18.869	16.532	-1.0032
1958	18.405	15.449	-.2237
1959	18.275	18.382	.4512
1960	19.407	22.046	-.0073
1961	20.425	22.945	-.3887
1962	20.705	22.768	-.1626
1963	22.050	22.027	.8774
1964	23.330	24.301	.3543
1965	24.417	19.169	
1966	24.975	18.618	

*Price of Choice Slaughter Steers at Chicago Divided by Price of #2 Corn

Figure 6



DATA FOR ESTIMATING BEEF CATTLE NUMBERS

YEAR	C' EST. BEEF COW NO.	V_{t-12} / C_{t-12} CALF-COW RATIO	B_{t-12} / C_{t-12} BULL-COW RATIO	Y' BEEF STEERS & HEIFERS (EST.)	I-I' OBSERVED MINUS EST. BEEF CATTLE NO.	I' EST. BEEF CATTLE NO.
	MIL. HD.			MIL. HD.	MIL. HD.	MIL. HD.
1947	15.754	.7807	.115	11.489	1.52	41.35
1948	16.225	.7766	.111	11.427	-1.06	42.06
1949	16.507	.7524	.110	10.823	.00	41.56
1950	17.022	.7559	.106	10.403	.42	42.09
1951	17.918	.7475	.101	12.924	.64	46.04
1952	20.407	.7729	.091	14.416	.38	52.46
1953	23.391	.7587	.084	15.096	.10	58.22
1954	24.869	.7488	.082	15.415	-1.43	60.94
1955	25.332	.7177	.076	15.271	.55	60.70
1956	25.646	.7328	.071	15.634	-.21	61.90
1957	25.331	.7437	.069	15.653	-2.01	61.58
1958	24.564	.7502	.070	15.434	-1.20	60.41
1959	24.855	.7563	.067	16.139	1.16	61.46
1960	26.769	.7728	.064	17.618	-.73	66.79
1961	28.053	.7753	.064	18.412	-2.44	69.99
1962	28.295	.7640	.063	18.627	.13	70.32
1963	29.277	.7790	.060	19.399	1.84	73.25
1964	30.965	.7785	.058	20.154	1.80	77.03
1965	32.509	.7683	.057	20.217		79.56
1966 1/	32.747	.7683	.057	20.011		79.78
1966 2/	32.911	.7683	.057	20.011		80.08

1/ Cow Inventory Estimated Using Equation (4)
2/ Cow Inventory Estimated Using Equation (3)

Figure 7

estimates made using a balance sheet approach. The estimated December 31 closing inventory compares with the following January 1 beginning inventory. The two estimates are never exactly equal because the beginning inventory and the supply and disappearance factors are all results of independent surveys. This balance sheet is shown in table 2.

Table 2.--Balance sheet for dairy and beef cattle on farms, 1947-64

Year	Total supply (dairy and beef)				Disappearance					Estimated closing total inventory Dec. 31	Dairy cattle inventory	Estimated closing beef cattle inventory Dec. 31
	Beginning inventory Jan. 1	Calves saved	Imports	Total supply	Slaughter: Cattle	Slaughter: Calves	Exports	Death loss of cattle and calves	Total disappearance			
	1,000 head											
1947.....	80,554	34,703	85	115,342	22,404	13,726	10	3,930	40,070	75,272	36,169	39,103
1948.....	77,171	33,125	462	110,758	19,177	12,378	7	3,635	35,197	75,561	35,270	40,291
1949.....	76,830	33,748	433	111,011	18,765	11,398	5	3,840	34,008	77,003	35,455	41,548
1950.....	77,963	34,899	461	113,323	18,614	10,501	8	3,742	32,865	80,458	35,398	45,060
1951.....	82,083	35,825	238	118,146	17,084	8,902	8	3,863	29,857	88,289	35,235	53,054
1952.....	88,072	38,273	140	126,485	18,625	9,388	11	4,034	32,058	94,427	35,921	58,506
1953.....	94,241	41,261	198	135,700	24,465	12,200	15	4,060	40,740	94,960	36,161	58,799
1954.....	95,679	42,601	86	138,366	25,889	13,270	21	4,063	43,243	95,123	35,342	59,781
1955.....	96,592	42,112	314	139,018	26,587	12,864	35	4,052	43,538	95,480	34,209	61,271
1956.....	95,900	41,376	159	137,435	27,755	12,999	37	3,912	44,703	92,732	33,291	59,441
1957.....	92,860	39,905	728	133,493	27,068	12,353	44	3,801	43,266	90,227	31,962	58,265
1958.....	91,176	38,860	1,152	131,188	24,368	9,738	26	3,810	37,942	93,246	30,708	62,538
1959.....	93,322	38,938	709	132,969	23,722	8,072	51	3,876	35,721	97,248	30,181	67,067
1960.....	96,236	39,353	663	136,252	26,026	8,611	32	4,098	38,767	97,485	29,974	67,511
1961.....	97,319	39,911	1,043	138,273	26,467	8,081	24	4,008	38,580	99,693	29,550	70,143
1962.....	99,782	40,961	1,250	141,993	26,905	7,854	19	4,112	38,890	103,103	28,651	74,452
1963.....	103,512	41,744	852	146,108	28,059	7,198	20	4,032	39,309	106,799	27,654	79,145
1964.....	106,260	42,563	[1] 600	149,423	[1] 31,145	[1] 7,490	[1] 20	[1] 4,100	42,755	106,668	[1] 27,000	79,668

[1] These are estimates made October 1.

762-270 O - 65 - 3

The balance sheet approach is a straightforward and powerful device used by many commodity analysts to depict the total supply, disappearance, and remaining inventory of a commodity at a given time. Total supply of all cattle consists of the January 1 inventory plus the calves born and saved plus cattle that are imported. The number of cattle that disappear or are taken from this supply consist of all cattle and calves that are slaughtered, cattle that are exported, and cattle that die. After these numbers are deleted from supply all cattle remaining make up the closing inventory of cattle, which should be the same as the beginning inventory for the next period.

For cattle and calves the ending or closing inventory of December 31 is used as an estimate of the beginning inventory on the following January 1. To get estimates of the closing inventory estimates of disappearance must be made before December 31. The estimates of the closing inventory for December 31, 1964, in this case were made about 3 months in advance. This closing inventory should be the same as the January 1, 1965, inventory. However, as an estimator it is only as good as the previously made estimates of disappearance.

An Analysis of Intraseasonal Apple Price Movements

By E. C. Pasour, Jr.

RESULTS OF AN ANALYSIS of U.S. apple prices at the farm level during the postwar period, 1947-61, are presented here.[1] The primary emphasis is placed upon determining and measuring the effects of factors associated with changes in apple prices during various periods of the apple marketing season. Previous work in this area has been quite limited. Most analyses of apple prices have dealt with changes in the season average price instead of focusing on intraseasonal or within-year price changes.

Season average farm price, as used in this study, refers to the average price during the marketing season. The apple marketing year is assumed to begin in July and end the following June. Many varieties and grades of apples are sold in the fresh market. The fresh price (reported monthly by the U.S. Department of Agriculture) is a blend price covering all varieties and grades.

Some of the more important policy questions in apple marketing cannot be answered on the basis of an analysis of season average prices. Among these questions are: (1) What is the most profitable allocation of apples between fresh and processing outlets? (2) Would a diversion program between alternative outlets be feasible for apple producers? (3) What part of the apple crop should be stored at harvest, and what is the optimum rate of movement from storage? In studying these problems, information is needed about demand conditions during various periods of the apple marketing season. This paper gives results of a model designed to provide this information.

The quantity of apples to store and the rate of sale from storage present major problems to the apple producer in each marketing season. Storage since World War II has been generally profitable only in certain years. Apple prices were lower at the time of storage during 4 of the 15 postwar years. In at least 2 of the remaining 11 years, the increase in price during the marketing season was not sufficient to cover storage costs.[2]

There is a problem in comparing apple prices at the beginning and end of the marketing season since the percentage of various grades and varieties marketed varies during the season. In general, however, the higher priced apples are placed in storage, so that the change in reported blend price may overstate the actual per bushel gross return to storage.

The decision as to whether to store apples must be made at harvest. At the same time supplies are being allocated to the fresh and processing markets, in areas where both outlets are available. These decisions are interrelated and the quantities stored and sold in each outlet are jointly determined with prices in the various markets. There are substitution possibilities on both the supply and demand sides.

On the supply side, approximately one-third of United States apples are "dual purpose" varieties.[3] These apples are about equally suitable for either fresh use or for processing. In addition, some varieties classified "fresh" are also often used in processing outlets. The problem in this case is to determine the most profitable allocation of the apple crop between fresh and processing forms of utilization. In addition to fresh vs. processing allocation, there is also a problem of distributing the fresh-market sales throughout the year at the most profitable rate.

On the demand side, empirical evidence suggests that consumers consider fresh apples and processed apple products to be

[1]Ronald A. Schrimper, Department of Agricultural Economics, North Carolina State, provided a number of helpful suggestions on an earlier draft of this paper.

[2]E. C. Pasour, "Analysis of Intraseasonal Apple Price Movements," Ph.D. dissertation, Michigan State University, Dept. Agr. Econ., 1963, p. 6.

[3]Dana G. Dalrymple, 'Economic Aspects of Apple Marketing in the U.S.," Ph.D. dissertation, Michigan State University, Dept. Agr. Econ., 1962, p. 16.

substitutes.[4] That is, a high price for processed apple products relative to fresh apples tends to increase fresh apple purchases. Substitution possibilities on the supply and demand sides result in a high degree of interdependence among apple markets at the farm level.

In this study, the Cromarty-Boger model was reformulated in view of structural changes in the U.S. apple industry since World War II.[5] U.S. apple exports and imports have been low in the postwar period. Consequently, I adjusted production data for exports and imports rather than formulate an export function (to explain changes in apple exports) as part of the overall model.[6]

The analysis was based on aggregation of the data into three within-year time periods or seasons. Selection of the specific periods used was based primarily on the economic and technical or physical characteristics of the apple industry, but was partly influenced by practical data limitations.

In the behavioral model of the apple market, quantities of apples stored, processed, and sold on the fresh market are jointly determined. As a result, the use of simultaneous equations to estimate the relationships comprising the economic model becomes logically appropriate during certain periods of the apple marketing season. For these periods, relationships were estimated using both ordinary least-squares and two-stage least-squares estimation procedures (5, pp. 258-260).[7]

[4]W. H. Drew, "Demand and Spatial Equilibrium Models for Fresh Apples in the United States," Ph.D. dissertation, Vanderbilt University, Dept. Econ., Jan. 1961, pp. 213-214. At the retail level, Drew obtained a positive cross elasticity coefficient of 0.32 between fresh apple purchases and price of canned apples (the price elasticity of demand for fresh apples was -1.10). A positive cross elasticity coefficient of 0.67 was obtained between canned apple purchases and prices of fresh apples (the price elasticity of demand for processed apples was -0.73).

[5]W. A. Cromarty, "An Experiment in Designing an Econometric Model to Explain Short-Term Demand Fluctuations for Apples," M.S. thesis, Mich. State Univ., Dept. Agr. Econ., July 1953; and L. L. Boger and W. A. Cromarty, "A Model to Explain the Short-Term Demand for Apples," paper presented at Econometrics Society meeting, Washington, D.C., Dec. 28, 1953.

[6]The rationale for this decision is presented in Pasour, op. cit., pp. 23-33.

[7]Underlined numbers in parentheses refer to items in the Literature Cited, p. 30.

After estimating the various relationships of the model, findings of this and other studies are related to apple marketing policy. Storage "rules" are developed to illustrate the possibility of improving storage decisions through the application of price prediction equations.

The Economic Model

The apple marketing year begins in July. Almost all apples are harvested during period I, July through November. During the harvest period, large quantities of apples are moved in the fresh market, but apple processing and storage are also important.[8] Thus, processing and fresh prices are determined simultaneously with the allocation by producers of apples into fresh or processing markets or into storage.

During period II, December through March, apples move out of storage to meet the demand in the fresh apple market. Apple processing occurring after period I is negligible and was ignored in this study.

Period III includes the months of April through June. When contrasted with period II, a much larger proportion of the apples sold in period III are controlled atmosphere (CA) apples.[9] In this study, all apples stored in any marketing season were assumed to be sold prior to July 1 since quantities sold after this date are very minor.

The total quantity of apples produced in any year was considered predetermined. Small quantities of apples may be left unharvested or culled during the marketing season because of price or price expectations. However, only to this very small extent can the season's supply of apples be considered endogenous.

Summary of the model.--Storage stocks information was obtained from the International Apple Association while quantities produced and processed were taken from publications of the Crop Reporting Board. A small quantity of apples

[8]From 1947 to 1961, processing utilization averaged about 30 percent of total apple production. The percentage of annual production of fall and winter varieties (which comprise about 95 percent of total production) in storage on December 1 varied between 35 and 45 during the same period.

[9]With this method of storage, a special atmosphere is maintained in a sealed storage room. The bulk of all stored apples is placed in regular refrigerated storage.

moves in and out of storage in period I, but the extent of this movement is not known.

All production and quantity variables were put on a per capita basis to adjust for changes in population. Since the periods of the analysis were of unequal length, quantity variables were put on a monthly or yearly basis to facilitate the comparison of coefficients for any given variable in different periods. To adjust for changes in the price level, farm prices were deflated by the Wholesale Price Index.

Income was assumed to be predetermined although changes in apple prices have a small influence on disposable income. Income data are reported on a quarterly basis and do not coincide with the three time periods used in this analysis. Income during period I was a weighted average of consumer disposable income during the third and fourth quarters. A weighted average of consumer disposable income during the fourth quarter of year t and the first quarter of year (t + 1) was constructed to get y_{2t}. In period III, y_{3t} equals consumer disposable income in the second quarter.

In the formulation which follows, the jointly dependent or current endogenous variables appear first in each relationship and are separated from predetermined variables by a semicolon. The subscripts m and t indicate, respectively, the period and marketing year being considered. The period in which each relationship of the model holds is indicated by an X to the right of the relationship.

	Period		
	I	II	III
(1) $f_{mt}, p^f_{mt}; p^f_{(m-1)t}, y_{mt}, c_{mt}$	x	x	x
(2) $a_{1t} + f_{1t}, p_{\overline{1t}}; A_{1t}$	x		
(3) $p_{\overline{1t}} \equiv \gamma_1 p^f_{1t} + \gamma_2 p^a_{1t}$	x		
(4) $a_{1t}, \frac{p^a_{1t}}{p^f_{1t}}; m_t, n_t$	x		
(5a) $s_{1t}, \frac{p^a_{1t}}{p^f_{1t}}; m_t, n_t$	x		
(5b) $s_{2t}; k_{1t}, S_{1t}$		x	
(6) $S_{(m-1)t} + q_{mt} \equiv f_{mt} + a_{mt} + S_{mt}$	x	x	x

where:

f_{mt} = pounds per capita of fresh apples, moved out of storage (not necessarily sold) in period m and year t on a monthly basis (m = 1, 2, 3,; t = 1947, 1948, ..., 1961).

p^f_{mt} = farm price of fresh apples in cents per pound deflated by the Wholesale Price Index. Monthly prices (taken from "Agricultural Prices") were averaged to obtain the price indicator in each of the three periods.

p^a_{1t} = deflated season average farm price in cents per pound of all processing apples (from Crop Reporting Board statistics).

y_{mt} = per capita consumer disposable income in 100-dollar units, on an annual basis, deflated by the Consumer Price Index.

c_{mt} = per capita marketings (in pounds) of peaches, pears, and California table grapes. Sales rather than prices of competing fruits were included as an exogenous variable because sales are more nearly predetermined.

a_{1t} = farm sales of apples (in pounds) for processing on a per capita basis.

A_{1t} = per capita carryover stocks (in pounds) of canned and frozen apple slices and sauce in canners' hands at the end of July. These stocks would include almost entirely products carried over from the previous apple marketing season.

$p_{\overline{1t}}$ = a weighted average of p^f_{1t} and p^a_{1t}, where the weights, $\gamma_1 + \gamma_2$ (with $\gamma_1 + \gamma_2 = 1$), were based on sales of fresh and processing apples during period I.

m_t = per capita Eastern apple sales (in pounds) in year t. Eastern production is labeled as such by the crop reporting service. Production of 14 Eastern States from Maine to North Carolina is included.

n_t = per capita apple sales (in pounds) in other parts of the United States in year t. "Other production" equals total production less Eastern production.

S_{mt} = per capita apple storage holdings at the end of period m of year t.

s_{mt} = $S_{mt} - S_{(m-1)t}$. In period I, s_{1t} is positive. s_{mt} is negative in periods II and III indicating the rate of movement out of storage during the two periods.

k_{1t} = percentage of stored apples in CA storage on December 1.

Four stochastic functions [(1), (2), (4), and (5)] and two identities [(3) and (6)] comprise the model. Of the stochastic functions, (1) is a demand relationship for fresh apples,[10] (2) is a demand relationship for all apples sold in period I,[11] (4) is the allocation function for all processing apples, while (5a) and (5b) are storage functions for periods I and II, respectively. Of the identities, (3) defines $p_{\overline{1t}}$ and (6) is a storage-stocks relationship which holds during each period of the apple marketing season.

The latter identity states that for any period of any crop year, the supply of apples at the beginning of the period, $S_{(m-1)t}$, plus the quantity harvested during the period, q_{mt}, constitute the total supply. This supply is equal to the quantity stored at the end of the period, S_{mt}, plus the quantities sold during the period in the fresh market, f_{mt}, and in the processing market, a_{mt}.

The above formulation represents a complete economic model for apples during each of the three periods of the marketing season.[12] In the model for period I, there is a demand relationship for fresh apples and one for total apple sales at farm level. In addition, apples may be stored during this period by the grower and moved into the fresh market later in the marketing season. Current endogenous variables in period I are f_{1t}, a_{1t}, s_{1t}, p^{f}_{1t}, p^{a}_{1t}, and $p_{\overline{1t}}$. Every relationship of the model holds in period I.

No processing occurs in period II. In this period, f_{2t}, p^{f}_{2t}, and s_{2t} are current endogenous variables. The fresh demand function (1), the storage function (5b), and the storage stocks identity (6) are the relevant relationships in period II.

In period III, storage movement is predetermined (movement equals stocks at beginning of period) and there is no processing. In this period, there is one current endogenous variable, p^{f}_{3t}, and the relevant relationships are (1) and (6). There is really just one equation since the identity in period III reduces to $S_{2t} = f_{3t}$ and f_{3t} is a predetermined variable in (1).

Each equation in periods I and II satisfies the necessary condition for overidentification in the standard linear simultaneous equations model; namely, the number of predetermined variables in the system less the number of predetermined variables in each equation is greater than the number of current endogenous variables in that equation minus one.

The Estimated Relationships

The estimated relationships were quite similar in log and nonlog form. In most cases, the results estimated in log form are not discussed.[13]

Relationships based upon 15 observations (1947-61) were estimated by ordinary least-squares (OLS) and by two-stage least-squares (TSLS).

In testing the regression coefficients, a one-tailed t test was used since a priori information indicates the direction of the effect of each predetermined variable upon the dependent variable. The 0.05 and 0.10 levels of significance

[10] In this study, the quantity of apples sold was related to farm or wholesale prices along with a group of consumer "demand shifters" such as income and competing fruits. Hence, the demand relationships of this study are not behavior relations in the strict sense but are "partially reduced form" equations.

[11] In preliminary trials, the model contained a processing apple demand relationship. In this relationship, the quantity of apples processed was a function of processing price as well as carryover stocks and other possible demand shifters. Satisfactory results were not obtained in estimating this relationship (the coefficient of price was positive). Consequently, the model was revised to incorporate a demand function for all apples sold (fresh and processing) during the harvest period.

[12] The model is complete in the sense that there are as many equations as current endogenous variables in each period. In this study, functions were estimated to explain changes in quantities of apples which producers wish to store (s_{1t}) and to sell to processors (a_{1t}). The quantity producers sell fresh was treated as a residual. The choice of treating the quantity of fresh apples sold as a residual was largely arbitrary. With production predetermined, functions explaining changes in any two of the three quantities (f_{1t}, a_{1t}, s_{1t}) may be estimated and the third treated as a residual.

[13] Standard assumptions were made concerning the error term, u, in the estimation procedures of this study. See, e.g., Johnston (5, pp. 107, 232).

are considered relevant, and are designated by ** and *, respectively. Since two-stage error formulas are asymptotic, tests are only valid asymptotically, strictly speaking (6, p. 5).

Period I.--The TSLS estimate of the model during this period follows. [14]

$$(1)\ \hat{f}_{1t} = 2.40 - 0.04p^{f}_{1t} - 0.08p^{f}_{3(t-1)} + 0.34c_{1t} - 0.06y_{1t}$$
$$t_b \qquad 0.39 \qquad 1.60 \qquad 2.25 \qquad 1.12 \qquad \bar{R}^2 = 0.63$$

$$(2)\ \hat{p}^{f}_{1t} = 8.33 - 1.22(a_{1t} + f_{1t}) - 0.70A_{1t}$$
$$t_b \qquad 5.57^{**} \qquad 4.29^{**} \qquad \bar{R}^2 = 0.69$$

$$(3)\ \hat{a}_{1t} = -7.80 + 5.92\frac{p^{a}_{1t}}{p^{f}_{1t}} + 0.84m_t + 0.19n_t$$
$$t_b \qquad 2.77^{**} \qquad 12.38^{**} \qquad 3.05^{**} \qquad \bar{R}^2 = 0.92$$

$$(4)\ \hat{s}_{1t} = -2.61 - 0.13\frac{p^{f}_{1t}}{p^{a}_{1t}} + 0.24m_t + 0.68n_t$$
$$t_b \qquad 0.45 \qquad 1.93^{**} \qquad 6.53^{**} \qquad \bar{R}^2 = 0.80$$

In accordance with traditional demand theory, the coefficient of price was expected to have a negative sign. Lagged fresh price was included as an explanatory variable on the presumption that consumption now and consumption next period are substitutes. Hence, an increase in $p^{f}_{(m-1)t}$ was expected to be associated with an increase in f_{mt}. Apples were assumed to be a normal good. An increase in carryover stocks, A_{1t}, was expected to decrease the demand by processors for apples in the current marketing season.

The results in period I seem quite good except for the demand relationship for fresh apples [(1)].

Coefficients of income (y_{1t}), competing fruits (c_{1t}), and lagged fresh price ($p^{f}_{3(t-1)}$) have "wrong" sings in (1). Downward trends in f_{1t} and c_{1t} and an upward trend in y_{1t} may provide an explanation of the perverse signs of c_{1t} and y_{1t}. The effect of fresh price on sales is not significantly different from zero at an acceptable level. When c_{1t} and y_{1t} were replaced by a trend variable and lagged price was eliminated, the estimated fresh apple demand relationship became more consistent with conventional demand theory.

The estimated demand function for fresh apples in period I when a trend variable was added and y_{1t}, c_{1t}, and $p^{f}_{3(t-1)}$ were dropped from the analysis with all data transformed to logs was:

$$(1\text{-}I)\ f_{1t} = 8.57 - 0.35p^{f}_{1t} - 0.10T$$
$$t_b \qquad 1.70^{*} \qquad 2.97^{**} \qquad \bar{R}^2 = 0.46$$

f_{1t} and p^{f}_{1t} are as defined previously in logs, and T = trend (1947 = 1, 1948 = 2, ..., 1961 = 15) in logs.

The elasticity of demand for fresh apples in period I based upon (1-I) was -0.35. [15] The elasticity of demand based on average prices and sales for all apples sold during the period computed from (2) was -0.60. [16] The effect of changes in period I total sales upon changes in average price was highly significant in this estimated relationship. A comparison of standard errors suggests, however, that the relationship between sales and price was measured more accurately in (2) than in (1-I). Also, the fit of (2) was considerably better than that of (1-I). The reason that demand functions were more satisfactory for combined fresh and processing apples than for fresh apples in period I is not clear. If demand is more inelastic for fresh apples than for total sales in period I, this implies that demand is more inelastic for fresh than for processing apples during the harvest period.

The trend variable in (1-I) was highly significant and indicates that the net effect of the many factors not included in the analysis was to decrease the demand for fresh apples.

Allocation function.--The allocation function for all processing apples explained a large part of the year-to-year variation in sales. All signs were as hypothesized. An increase in the

[14] The $\bar{R}^2$ values presented along with relationships estimated by two-stage least-squares were based on estimated instead of observed values of all endogenous variables except the variable that is dependent in the second stage.

[15] When this relationship was fitted in nonlog form, the elasticity of demand at the mean values of price and quantity was -0.38.

[16] The reciprocal of price flexibility was taken to be the price elasticity of demand. In log form the elasticity of demand was -0.61.

processing-fresh-apple price ratio would tend to result in more apples being allocated to the processing sector. An increase in production would also tend to be associated with an increase in the quantity of apples processed. Since a much higher part of the Eastern States' crop goes into processing uses than the crops in other areas, it is not surprising that Eastern production (m_t) was a more important explanatory variable than other production (n_t).

Storage function.--A change in the ratio of fresh to processing apple prices had no significant effect on the quantity stored. The larger effect on initial storage of non-Eastern production seems reasonable since a larger proportion of these apples is moved in the fresh market.

The fresh apple demand function was the least satisfactory of the estimated relationships for period I. In general, OLS and TSLS estimates were quite similar. In retrospect, it is not surprising that the estimating procedures yielded similar results of (2) and (5a), for the following reason. In period I, production is predetermined and initial storage was shown to be mainly determined by production. Since $q_{1t} = a_{1t} + f_{1t} + s_{1t}$, then $a_{1t} + f_{1t}$ should be largely predetermined. Thus, one might expect the OLS estimate of (2) to be quite good when this relationship is estimated with the price dependent.

Period II. In period II, the producer has the alternative of selling on the fresh market or of leaving his apples in storage for sale in period III. Hence, the quantity of apples remaining in storage and fresh sales from storage, f_{2t}, are jointly determined. In the storage function of period II, s_{2t} is negative. The estimated relationships of period II (TSLS) are:

$$(1\text{-II})\quad \hat{p}^{f}_{2t} = 9.66 - 2.37f_{2t} + 0.41p^{f}_{1t} - 1.15c_{2t} - 0.13y_{2t}$$
$$t_b \qquad\quad 8.29^{**} \quad 2.83^{**} \quad 2.53^{**} \quad 2.12$$
$$\bar{R}^2 = 0.92$$

$$(5b)\quad \hat{s}_{2t} = 1.90 - 0.58S_{1t} + 0.04k_{1t}$$
$$t_b \qquad\quad 14.67^{**} \quad 1.70^{*}$$
$$\bar{R}^2 = 0.95$$

These results are generally consistent with a priori reasoning.[17] In (1-II), however, the coefficient of income has the "wrong" sign. It is likely that the effect of income which has a strong upward trend is being masked by the effects of other variables.

At the mean values of sales and price, demand was inelastic for fresh apples in period II (-0.78) but appeared to be more elastic in period II than in period I.

Initial storage stocks, S_{1t}, from 1947 to 1961, explained about 93 percent of year-to-year changes in storage stocks during period II. These stocks constitute the total available supply during period II since harvest is completed during period I. Apples, in general, will be stored and remain in storage as long as the expected price at a later date exceeds the current price plus storage costs (allowing for risk, spoilage, etc.). An increase in S_{1t} is likely to adversely affect the producers' expectations concerning future prices. With constant storage costs, a decrease in expected future price would likely be associated with an increase in movement from storage during any period.

CA storage costs are approximately one and one-half times as high as costs of regular refrigerated storage. This increase in costs, however, has been more than compensated for by the price premium realized for CA apples. Under these conditions, one might expect an increase in CA storage to be associated with an increase in future price and a decrease in movement from storage in period II.

The estimated storage functions for periods I and II indicate that the aggregate behavior of apple storage operators can be represented quite accurately by simple functional relationships of the type used in this study.

Period III. All apples in storage at the beginning of period III are sold (in the fresh market) during the period. In this case, the OLS method of estimation (with price dependent) becomes a valid application of the simultaneous equations theory and the methods are identical. The estimated relationship of period III was:

$$(1\text{-III})\quad p^{f}_{3t} = 3.03 - 2.63f_{3t} + 0.49p^{f}_{2t} + 1.21c_{3t} + 0.09y_{3t}$$
$$t_b \qquad\quad 3.89^{**} \quad 2.79^{**} \quad 1.41 \quad 0.81$$
$$\bar{R}^2 = 0.84$$

Only the coefficient of competing fruits (c_{3t}) has the "wrong" sign in (1-III). It is likely that

[17] OLS and TSLS estimates differed little in period II. This is not surprising since s_{2t} (hence, f_{2t}) from (5b) is shown to be largely determined by s_{1t} and k_{1t} which are predetermined.

c_{3t} is acting as a proxy variable for factors not included in the analysis.

In periods II and III, an increase in fresh price in the previous period was associated with a price increase in the current period. These results alone do not support the hypothesis that consumption is substitutable between periods since prices in successive periods are highly positively correlated. However, similar results were obtained when quantity was considered dependent. Thus, consumption appears to be substitutable between periods, at least to some extent.

The elasticity of demand in period III, at the mean values of fresh sales and price, is -1.85--apparently higher than the elasticities of periods I and II.[18] However, the average quantity of sales was less in period III than in period II and was less in period II than in period I.

Elasticities computed from annual data by other researchers were similar to those computed in this study. Using simultaneous equations estimation procedures with annual data, Tomek and Brandow obtained elasticities of -0.46 and -0.73, respectively, for fresh apples. Elasticities obtained for processing apples were -0.57 and -0.21 (1, p. 20; 10, pp. 26-28).

Seasonal Changes in Elasticity of Demand

Elasticity of demand for most commodities is likely to vary depending on the length of time involved. There are two opposing forces affecting the elasticity of demand. Short-time elasticities (e.g., week or month) are likely to be greater than longer-time elasticities (e.g., year) since a large part of the short-term fluctuations in quantities marketed can be absorbed by storage operations (8, p. 64). Annual fluctuations in quantities marketed of a semiperishable commodity such as fresh apples, however, cannot be absorbed in this manner.

The ease of substitution is another force affecting elasticity of demand. The more time allowed for adjustment to a price change, the greater the adjustment is likely to be. Thus, we expect elasticities to be greater in the long run than on an annual basis. Within short periods of time, the substitution effect on elasticity is likely to be more than offset by the opposite effect of storage.[19]

In addition to problems with respect to the time period involved, the demand function may shift during the season. A limited amount of empirical work has been concerned with intraseasonal shifting of demand for fruits and vegetables. In demonstrating that intraseasonal shifts in demand occur, it must be shown that intraseasonal price changes cannot be explained by changes in quantity placed on the market. Results of this study suggest that the demand for fresh apples is more inelastic than the demand for processing apples during the harvest period. Demand for fresh apples appears to become less inelastic as the marketing season advances and to become elastic near the end of the marketing season.

Implications

There is current interest in exploring alternative apple marketing policies. A diversion program for fresh and processing apples has been discussed by a number of writers (2 and 3). Under a program of one type, sales of fresh apples would be restricted and the surplus allocated to processing outlets. The underlying premise of such a program is that the demand for fresh apples is more inelastic (at the farm level) than the demand for apples going to processors. Empirical evidence concerning the relative elasticities of demand for fresh and processing apples at the farm level is mixed. An additional difficulty is that these estimates were based on annual data and results from this study indicate that the elasticity of demand for fresh apples may vary during the marketing season.

A satisfactory demand function for processing apples was not obtained in this study.[20] The

[18] When all data were transformed to logs, the elasticity of demand was -1.33 in period III.

[19] The first force might also be considered as representing a substitution effect of a special kind. That is, the short-term fluctuations in quantities marketed absorbed by storage operations represent a substitution of consumption in a later time period for consumption in the present time period. The shorter the period of time involved, the easier it is to make this substitution.

[20] Price prediction functions for processing apples were more satisfactory (7). See E. C. Pasour and D. L. Oldenstadt, "Farm Prices of Apples for Canning and Freezing in the United States, 1951-1961," U.S. Dept. Agr., Agr. Econ. Rpt. No. 35, (Washington: U.S. Government Printing Office, 1963.)

evidence indicated that fresh apples in period I had a more inelastic demand than the demand for total sales, implying that the demand was more elastic for processing apples. The analysis was not adequate, however, to conclude that there was, in fact, a difference in the elasticity of demand in processing and fresh apple markets. In view of the uncertainty and conflicting empirical findings with respect to the relative elasticities of fresh and processing apples at the farm level, a diversion program for apples does not appear feasible to this writer at the present time.

Optimum allocation over time.--Another policy problem revolves around the question of how to optimally allocate fresh apples during the marketing season. Theoretically, returns can be maximized by allocating a commodity over time in the same way as between different markets at any given point in time. Net returns would be maximized when the marginal revenues were equal in each time period, assuming marginal costs were equal.

When a difference in time is involved, there is usually a difference in total costs due to storage costs, and possibly in marginal costs. The allocation principle remains the same, however, when marginal costs differ in different time periods. In such cases, net returns would be maximized by equating marginal net revenue in each time period, where marginal net revenue is defined as the difference between marginal revenue and marginal cost in any market.

In the case of apples, net returns would be maximized over time by equating properly discounted marginal net revenues in fresh and processing markets for periods I, II, and III. Information relating to storage costs and demand conditions in various periods of the apple marketing season is necessary to determine the most profitable marketing pattern. The attempt to determine separate demand functions for fresh and processing apples during the harvest period in this study was not successful enough, it was felt, to warrant using the estimated functions as the basis for constructing marginal revenue functions. Estimated price prediction equations, on the other hand, appeared relatively satisfactory. In the following section, to illustrate the possibility of improving storage decisions by use of price prediction equation, storage "rules" are developed such that (a) the quantity in storage at the end of period m (for m = 1, 2) is a specified function of variables observable in or before period m, and (b) the parameters of the function are determined so as to equalize the marginal cost of storage and the expected change in price. Equating marginal cost of storage and expected change in price does not maximize producers' or storers' expected revenue, but it does maximize the expected "social value" of storing activity, provided one accepts market price as the measure of the "marginal social value" of the commodity in utilization (4).

Storage Rules

The average within-year price increase from period I to period III during the period 1947-61 was $0.26 per bushel. Storage costs are about $0.23 per bushel for regular storage and $0.37 per bushel for CA storage and most apples are stored in regular storage facilities (9, p. 56). Hence, on the average, the price increase during the period of storage appears to have approximated the cost of storage. However, there has been wide variation from year to year in within-year price movements, and ipso facto large deviations in particular years from equality of price change with cost of storage.

Storage costs used in the following analysis were based on Thompson's study of apple storage costs in New York State (9). Storage costs, however, appear to be fairly constant over the United States. Marginal storage costs were assumed constant in developing the storage rules. After apples are stored, fixed costs of storage do not offset storage decisions in subsequent periods and variable storage costs are quite low. Storage costs between periods I and II and between periods II and III were taken to be $0.22 and $0.04 per bushel, respectively.[21]

Predictive equations for fresh apple prices.--In developing storage rules, price prediction equations are needed for each of the three periods of the analysis. Fresh apple price is difficult to predict early in the marketing season.

[21]The cost of storage in each period was weighted by the average percentage of apples in regular and CA storage facilities in that period.

A fairly good predictive relationship for fresh price in period II was obtained using July fresh price and the July apple crop estimate of the Department of Agriculture as explanatory variables. The July apple crop estimate during the postwar period has been quite accurate as an indicator of total production.

This estimated relationship based on data for the period 1947-61 is:

$$(7)\ \hat{p}^f_{1t} = 2.33 + 0.39p^f_{jt} - 1.76e_{jt}$$

$$t_b \qquad 1.73^* \qquad 3.49^{**} \qquad \bar{R}^2 = 0.67$$

where

p^f_{1t} = deflated U.S. average farm price in dollars per bushel of fresh apples in period I of year t.

p^f_{jt} = deflated U.S. average July farm price of fresh apples in dollars per bushel in year t.

e_{jt} = U.S. Department of Agriculture July apple crop estimate (for the United States) in bushels per capita in year t.

Lagged fresh price, $p^f_{3(t-1)}$, was initially included as an explanatory variable in this relationship. The effect of lagged fresh price, however, was not significant at the 0.10 level and it was dropped from the equation.

Changes in period I fresh price were closely associated with changes in total production or forecast. Taken together, July fresh price and apple crop estimate explained almost 70 percent of the variation in period I fresh prices from 1947 to 1961.

Relationship (7) was used instead of the fresh apple demand relationship of period I estimated in the previous section in developing storage rules for the following reason. As a fresh price predictive relationship, (7) explains a higher percentage of the period I price variation and contains explanatory variables estimated by the U.S. Department of Agriculture early in the apple marketing season.

Estimated relationships to predict fresh apple prices in periods II and III were adapted from the relationships previously presented. This involved elimination of lagged price as a variable from (1-II) and (1-III), and reestimation of these relationships by replacing c_{mt} and y_{mt} with a trend variable. When lagged price was left in, the quantity to store in the storage rule for period I or II was a function of current price.

The estimated relationships obtained for periods II and III are:

$$(8)\ \hat{p}^f_{2t} = 5.21 - 1.47f_{2t} - 0.02T_1 \qquad \bar{R}^2 = 0.84$$

$$(9)\ \hat{p}^f_{3t} = 3.63 - 2.44f_{3t} + 0.01T_1 \qquad \bar{R}^2 = 0.73$$

where:

p^f_{mt} = deflated U.S. average farm price in dollars per bushel of fresh apples in period m of year t.

f_{mt} = per capita sales (in pounds) of fresh apples in period m and year t on a monthly basis.

T_1 = trend (1947 = 1, 1948 = 2, ..., 1961 = 15).

Storage rule for period II.--In determining how many apples should be in storage at the end of period II, S_{2t}, the expected price change between periods II and III, is equated with marginal cost of storage between these periods. That is, the equation to be satisfied is:

$$(10)\ 5.21 - 1.47f_{2t} - 0.02T_1 = 3.63 - 2.44f_{3t} + 0.01T_1 - 0.04$$

where the left side is price in period II, the first three terms on the right are expected price in period III, and the fourth term on the right is the (constant) marginal cost of storage between periods II and III.

The quantity of sales during period II, f_{2t}, is equivalent to the quantity in storage in the beginning of period II, S_{1t}, less the quantity in storage at the end of the period, S_{2t}. All apples in storage at the end of period II are moved during period III. Consequently, $f_{3t} = S_{2t}$.

Substituting $(S_{1t} - S_{2t})$ for f_{2t} and S_{2t} for f_{3t} in (10) and solving for S_{2t}, we obtain S_{2t} as a function of S_{1t} and T_1. When these substitutions are made, the storage rule of period II is:

$$(11)\ \hat{S}_{2t} = 0.41 + 0.28S_{1t} + 0.01T_1$$

where:

S_{mt} = the quantity of apples stored at the end of period m in year t in pounds per capita.

Thus, the quantity of apples in storage at the end of period II under rule (11) is a positive function of the quantity on hand at the beginning of period II and the trend variable.

The storage rule for period II when net marginal revenues are equated in period II and III (instead of equating the expected price change) follows.

From (8) and (9) and the cost assumption, it follows that:

$$TR_{III} = p^f_{3t} f_{3t} = 3.63f_{3t} - 2.44f^2_{3t} + 0.01T_1 f_{3t}$$

$$TR_{II} = p^f_{2t} f_{2t} = 5.21f_{2t} - 1.47f^2_{2t} - 0.02T_1 f_{2t}$$

$$TC = .04S_{2t}$$

Then,

$$MR_{III} = 3.63 - 4.88f_{3t} + 0.01T_1$$

$$MR_{II} = 5.21 - 2.94f_{2t} - 0.02T_1$$

$$MC = 0.04$$

Substituting $S_{1t} - S_{2t}$ for f_{2t} and S_{2t} for f_{3t}, setting $MR_{II} = MR_{III} - MC$, and solving for S_{2t}, we obtain the storage rule,

$$S_{2t} = -0.21 + 0.38S_{1t} + 0.004T_1$$

which maximizes net returns in periods II and III. This rule is similar to (11). The coefficient of S_{1t} (the slope) is the same in each case, while the level of S_{2t} for a given quantity of S_{1t} is lower in the case where net returns are maximized.

Both of the "derived" storage rules for period II are similar to the estimated storage equation for that period which was

$$\hat{S}_{2t} = -1.90 - 0.58S_{1t} + 0.04k_{1t}$$

or since $S_{2t} = S_{1t} + s_{2t}$

$$\hat{S}_{2t} = -1.90 + 0.42S_{1t} + 0.04k_{1t}$$

Storage rule for period I.--In period I, the equation to be satisfied is:

$$(12)\ 2.33 + 0.39p^f_{jt} - 1.76e_{jt} = 5.21 - 1.47f_{2t} - 0.02T_1 - 0.22$$

where the left side is price in period I, the first three terms on the right are expected price in period II, and the last term on the right is the (constant) marginal cost of storage between periods I and II. Substituting $(S_{1t} - S_{2t})$ for f_{2t} and equation (11) for S_{2t} gives the following storage rule for period I:

$$(13)\ \hat{S}_{1t} = 2.26 - 0.43p^f_{jt} + 1.93e_{jt} - 0.01T_1$$

In this case, the quantity stored in period I is a function of July fresh price, July crop estimate, and the trend variable.

Application of Storage Rules

After the storage rules [(11) and (13)] were computed, they were applied to the years 1947-61 to see what difference their application would have made in the variability of seasonal price changes. For each year, using equation (13), the quantity was computed that would have been stored in period I applying the storage rule, $\hat{S}_{1t}$. Then substituting the quantities that would have been stored under the storage rule of period I, $\hat{S}_{1t}$, into (11), $\hat{S}_{2t}$ was computed for each year of the analysis.

After computing $\hat{S}_{1t}$ and $\hat{S}_{2t}$ from the storage rules, sales for periods II and III under the storage rules were computed. In these computations, $\hat{f}_{2t} = \hat{S}_{1t} - \hat{S}_{2t}$ and $\hat{f}_{3t} = \hat{S}_{2t}$. Then, the demand functions estimated in this study were used to determine the price that would have occurred in periods I, II, and III had the storage rule been in effect. The observed price of each period was adjusted by the following procedure which assumes that other factors affecting demand, e.g., competing fruits, income, etc., would not have been affected by the storage rules.

$$(14)\ \hat{P}_{mt} = p^o_{mt} - b_m(\hat{f}_{mt} - f^o_{mt})$$

where:

$\hat{P}_{mt}$ = the price which would have occurred in period m of year t had the storage rule been in effect.

p^o_{mt} = the observed price in period m of year t.

b_m = the regression coefficient of sales in the fresh apple demand function of period m.

$\hat{f}_{mt}$ = quantity of sales in period m of year t under the storage rule.

f^{o}_{mt} = the actual quantity of sales in period m of year t.

In period I, the difference in total apple sales due to the storage rule during the period 1947-1961 would be $(\hat{S}_{1t} - S^{o}_{1t})$, where S^{o}_{1t} is the quantity actually stored in period I and $\hat{S}_{1t}$ is the quantity that would have been stored under the rule (13). In computing $\hat{p}_{1t}$, b_1 was the regression coefficient of sales in the estimated demand relationship (of period I) for both fresh and processing apples presented previously. [22]

The change in fresh sales in period II that would have occurred had the storage rules been applied was determined as follows. Since $f_{2t} = S_{1t} - S_{2t}$, we have:

$$(15)\ \hat{f}_{2t} - f^{o}_{2t} = \hat{S}_{1t} - S^{o}_{1t} + S^{o}_{2t} - \hat{S}_{2t}$$

where all quantities are as previously defined. In period III, $f_{3t} = S_{2t}$. Therefore, $\hat{f}_{3t} - f^{o}_{3t} = \hat{S}_{2t} - S^{o}_{2t}$.

After computing the prices which would have occurred in period m and year t under the storage rules, $\hat{p}_{mt}$, seasonal price changes in $\hat{p}_{mt}$ were compared with seasonal price changes in observed price, p^{o}_{mt}. This comparison follows. Let

$$D^{o}_{12} = P^{o}_{2t} - P^{o}_{1t},\ D^{o}_{23} = P^{o}_{3t} - P^{o}_{2t},\ D^{o}_{13} = P^{o}_{3t} - P^{o}_{1t}$$

$$\hat{D}_{12} = \hat{P}_{2t} - \hat{P}_{1t},\ \hat{D}_{23} = \hat{P}_{3t} - \hat{P}_{2t},\ \hat{D}_{13} = \hat{P}_{3t} - \hat{P}_{1t}$$

D^{o}_{ij} is the observed price change between period i and j, and $\hat{D}_{ij}$ is the price change between period i and j which would have occurred under the application of the derived storage rules, (11) and (13). The variances of D^{o}_{ij} and $\hat{D}_{ij}$ were computed for the period 1947-1961. These results are summarized below.

	Periods of the Analysis		
	I - II	II - III	I - III
Variance of actual price changes (D^{o}_{ij})	0.095	0.089	0.212
Variance of estimated price changes ($\hat{D}_{ij}$)	0.089	0.064	0.053
Ratio of variances $\left(\frac{\text{estimated}}{\text{observed}}\right)$	0.937	0.719	0.250
Percentage decrease in variance under the derived storage rule	6%	28%	75%

There was a large reduction in variance (under the storage rules) of the price change from period I to period III, but the other two reductions were quite modest. The explanation for this outcome is not clear, but the computations at least suggest the possibility of improving storage decisions through the use of price prediction equations.

The decrease in variability in the seasonal price change under the storage rules would, in this case, have been accompanied by an increase in total revenue. In a comparison of sales and prices computed from the storage rules with actual prices and sales, total revenue was higher under the rules in 13 of the 15 years included in the analysis. The average annual increase in total revenue under the rules was about 2 percent. The application of the rules would have affected total costs very little since the average quantity stored under the rule was about the same as the actual average quantity stored. Hence, the percentage increase in net revenue would have been greater than the percentage increase in total revenue.

The above computations are indicative of the possible magnitude of the effect of improved storage decisions. The rules, however, were only applied to the same data from which the rules were developed, so that the substantial reduction in variability of the price change from period I to period III which was obtained is undoubtedly an "upper limit" estimate of the improvements which might be possible using price prediction equations of the fairly simple type presented

[22] A weighted price (weighted by f_{1t} and a_{1t}) was used as the price indicator in the demand relationship for combined fresh and processing sales. When this function was re-estimated with p^{f}_{1t} as the dependent variable, the coefficient of $(a_{1t}+f_{1t})$ changed very little (from -1.17 to -1.15).

here.[23] That is, if the rules were applied to data for a different period of time, the reduction in variability of the price change from period I to period III would probably not be as large as that obtained in this study.

The computed storage rules are aggregate inventory functions. Such rules, however, could be of value to individual apple producers. Apple harvest occurs only in period I. Prices during the remainder of the season are greatly influenced by the quantity of apples initially stored and the rate of sale from storage. Apple storage is profitable if the increase in price is more than enough to cover the costs of storage. Hence, if it appears that aggregate apple holdings will be less than that called for by (13) for period I or (11) for period II, the individual producer might profitably increase the quantity stored in period I or defer sales from period II to period III.

During the postwar period, changes in initial storage holdings in period I were explained quite well by the simple storage function presented earlier. After harvest, more than 90 percent of the change in storage movement between periods II and III was explained by change in initial storage holdings. The International Apple Association publishes monthly storage reports which indicate the level of aggregate storage holdings. The individual firm might use such data in conjunction with the storage rules to determine whether or not to change its own storage holdings. Such information could provide a basis for more orderly marketing.

The substantial degree of aggregation, geographic, temporal, and among grades and varieties may conceal profit opportunities associated with storage. Price variation within periods, differential rates of flow of apples within periods, and differing patterns of seasonal price variation in different regions may be misleading to producers in particular regions.

A further complicating factor in developing a storage policy for the apple industry is that all producers do not have the same costs and the same expected returns. For example, both costs and returns are higher under CA storage conditions. The individual producer needs information pertaining to his specific apples. However, a knowledge of total storage holdings and the probable price increase for all apples is useful since there is generally a high degree of substitution among varieties and grades of apples produced in different locations.

[23] Gustafson found, however, that a substantial reduction in the year-to-year variability of seasonal changes in price could be achieved by the application of storage rules, when the rules were based on data from an entirely separate period of years. (R.L. Gustafson, "Storage of Pork," unpublished manuscript, Mich. State Univ., 1959.)

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Book Reviews

Farm Goals in Conflict.

Edited by Earl O. Heady. Center for Agricultural and Economic Development. Iowa State University Press, Ames. 251 pages. 1963. $4.95.

Farm Policy: New Directions.

By Geoffrey S. Shepherd. Iowa State University Press, Ames. 292 pages. 1964. $6.95.

AS PATHS to understanding the problems of agriculture these two books published by the same press match the interdisciplinary symposium with the single scholar's study.

However, to call "Farm Goals in Conflict" interdisciplinary is almost an understatement. Its 17 authors include a theologian, 3 social scientists, and spokesmen for churches, Government agencies, and farm organizations.

To prepare readers for diverse content Hadwiger and Haroldsen open with a note that "a vigorous interdisciplinary meeting takes the neatness from our particular world and sometimes makes us wonder whether it exists at all."

But neatness is not the test of fruitful search for knowledge, and the apology was unnecessary. The group holds its own vis-a-vis the solo scholar.

If the several authors in the joint work come up with a salad of comments on the family farm, the justice of equitable income, and the lure of freedom from Government programs, Dr. Shepherd's "Farm Policy: New Directions" is itself not a model of consistency. A book apparently intended as an undergraduate text, it is an excellent catalog of alternative definitions of the farm problems and alternative solutions. But it does not follow through with equally impressive conclusions and recommendations.

Perhaps surprisingly, Dr. Shepherd's best section is the chapter on Development of Values, where he presents engaging ideas that contradict his earlier ones and tie to "Farm Goals in Conflict"--thereby also affording a double reason for pairing the two publications in this review.

In that chapter the author observes sagely that "new technology puts the farmer's conscience in a jam by placing in opposition his love of justice and his love of freedom." This parallels almost word for word Dr. Shirley Greene's remark in "Farm Goals in Conflict" on "the endless controversy between those who defend strong programs of government in the name of justice and those who resist ... in the name of freedom." Rev. Henry McCanna follows with the structural question of our age: "In the complex and interlocking economy of our time, can the individual grower hope to survive economically apart from some form of organized market bargaining power?"

Regrettably, Dr. Shepherd does not answer that question. The freshness manifest in his Values section--and in a good digression on the world food problem--does not permeate the book. He scarcely mentions bargaining power, and then only as an aspect of production control. The influence of farmers' markets on farm policy is bypassed.

And he joins countless other economists in pitching his study as a search for the unique farm problem, and the simple best answer for it.

In this reviewer's judgment, no misunderstanding so impedes farm policy studies as the premise that the problem is singular. It is not. It is plural. The farm problem is a price problem, and an income problem, and an excess manpower problem, and a market problem, and some other problems, simultaneously.

Dr. Shepherd's prescription is that "what is needed" is lots of job and training information for farm teenagers. That is not so much inaccurate as inadequate; and his book is better as Farm Policy than as New Directions.

The symposium which "Farm Goals in Conflict" reports was a rerun of an earlier one

in which the Iowa State Center first sought to approach farm policy by the goals route. In the second attempt the new element is the interdisciplinary makeup. Thereby is justified the jibe that "the first meeting ... didn't get very far, since ... those attending were exclusively social scientists."

Given their chance, the nonsocial scientists made the most of it. A 33-year-veteran rural pastor showed the best understanding of rural life. A national church leader chided farmers for bemoaning their own incomes while disregarding the low wages paid farm labor. The president of National Farmers Organization, no economist, reminded that the survival test in farming today is not efficiency but financial reserve. And another churchman put values and goals in proper perspective when he noted as "grotesque" that the "Farm Bureau should have a formal statement encouraging their members to keep their churches straight rather than expressing some degree of humility and need for the churches to keep the farm organization straight."

"Farm Goals in Conflict" as a collection is made immeasurably better by the introduction that begins it and the "Dialogue" that ends it. This is true even though the long exchange as to whether traditional agriculture offers unique values is unscholarly, tiresome, and beside the point. Any form of economic structure has associated social and political meaning. Agriculture has its own, and there is no need for either antagonism or defensiveness regarding it.

"Farm Goals in Conflict" and the Values chapter of "Farm Policy: New Directions" offer a promising avenue to consideration of national policy (economic and otherwise) for agriculture. As both are pioneers, neither deserves any discredit for not yet perfecting the approach.

Harold F. Breimyer

Elements of Regional Accounts.

Edited by Werner Z. Hirsch. The Johns Hopkins Press, Baltimore. 221 pages. 1963. $6.

THAT REGIONAL ACCOUNTING is a complex but growing area of economic investigation is readily apparent in this collection of conference essays and discussion papers sponsored by the Committee on Regional Accounts. A great weakness often evident in publications of this type--the lack of a well-integrated purpose--also plagues this volume. The subject matter ranges from (1) flows and the analysis of regional development, through (2) regional income estimates, (3) public finance in regional accounting, (4) a framework for metropolitan models, (5) the use of intrametropolitan data, (6) measurements of human resources, and (7) manpower movements, to (8) an integrated system of regional accounts. In this final chapter, Perloff and Leven attempt to bring together human and nonhuman resource bases, production, income, and government into one complete, consistent system. By their own admission, they fall short of their goal.

Regional accounting is a relatively new science compared with national income accounting and there is still much groping and probing going on in this area. Perhaps Professor Burkhead puts his finger on the reason when he states, "Those who have worked in recent years at the development of regional concepts and the measurements of regional activity are by this time aware that their efforts have no clearcut policy orientation. Regional accounting is not directed toward a set of regional policies nor toward an organizational structure, public or private, with the responsibility for regional well being." Moreover, much work in regional analysis has been to develop an accounting framework that will encompass all phases of economic activity, rather than following the scientific procedure of first identifying problems, then developing the theories to analyze them.

These essays show that there is a large gap between developed accounting models and the collection of data needed to utilize these models. One of the most important problems that needs to be solved is the selection of a basic geographic unit for the collection of data, i.e., county, district, metropolitan area, State, or other area. This problem receives limited attention in this volume. Apparently, it is difficult to reach a consensus because large areas such as States preclude many important types of analysis, and small units such as counties represent an almost overwhelming task in terms of time and resources, especially if regional

accounts are to be comparable to national income accounts. Until a generally accepted decision on the basic unit is made, it is unlikely that regional analysis can make much progress, especially in analyzing problems of interregional competition and economic development.

This writer wonders why activity analysis theory has not received more attention of the regional account analysts. Here is a theoretical system that has great promise for providing an integrated framework as well as having great analytic and problem-solving power.

There is not much empirical analysis in this book. Only one paper, by Edwin Terry, really comes to grips with a particular data problem--the allocation of personal income by regions. A few methods are analyzed, but the results are not very satisfying.

Although new students of regional accounting will find much helpful information in this volume, they would do well to first read an earlier similar volume, "Design of Regional Accounts," edited by Werner Hochwald and sponsored by the same Committee. Others interested in regional accounting will find that this readable monograph presents many new and useful concepts.

Alvin C. Egbert

Manpower in Economic Growth--The United States Record Since 1800

By Stanley Lebergott. McGraw-Hill Book Co., New York. 561 pages. 1964. $8.95.

HOW HAS MANPOWER in the United States been utilized and rewarded since 1800? What consequences has this pattern of use and reward had on the course of economic growth in this country?

To answer these questions, Lebergott draws on a tremendous array of historical materials, ranging from diaries and personal narratives to census data. He has developed new statistical series, and extensions of series from governmental and other sources, on employment, unemployment, wages, and costs of living. Analyses of the works of economists and quotations from writers of fiction are also utilized.

The author states that changes in manpower use and reward, which are associated with economic growth, can only be understood in terms of broad patterns of national belief and action. The energy that springs from hope, and the willingness to adopt innovations--national traits which arise partly from the spaciousness and fertility of the land--are major elements in the economic growth matrix. The national belief in a free society open to all talents, the geographic and upward mobility of labor, and the high degree of adaptability and inventiveness in uses of capital and labor are other basic elements.

Sources of supply of labor--slave, indentured, and free--are examined in historical perspective, as is the changing participation of certain groups, such as women and children, in the labor force. Attention is given to political and social, as well as to economic, changes influencing the sources and uses of labor.

The processes of economic growth are discussed. An understanding of how the labor force spread across the country is developed through comparison of regional differentials in wage rates of common labor with rates of population growth (or net migration). Changes in employment among major industry sectors are explored. In this regard some ingenious indexes and comparative estimates show relative and absolute changes in levels of employment by major industries between 1900 and 1960. The influence of social mobility and the division of labor on productivity and factors associated with the origins of the U.S. factory system are also discussed.

The development of the national labor market, trends in real wages and their determinants, and factor shares in the long term are viewed as consequences of economic growth. In dealing with sources of economic growth the author presents two central themes--the freedom that permitted the development and competition of ideas, and the combination and recombination of production factors developed from the competition among political, theological, social, economic, and technological ideas. He says that "the competition of ideas is no less significant than that of product markets in bringing economic advance," and that the competition of ideas meant that "the factor combinations suited to one stage in development were not retained

rigidly on into subsequent stages when their optimal value had been dissipated." The changing combinations of labor and other production factors, the relationship between factor substitution and productivity, and the influence of such things as education and employment stability on wage costs are considered in historic and economic terms.

The last half of the book presents a wide variety of statistical and documentary materials on trends in wages and earnings by occupation and industry, and on living costs. Chapters are included on the methods and data utilized in developing the annual series on labor force, employment, unemployment, full-time equivalent earnings, and other related matters. These chapters contain some of the major contributions of the book.

This is a valuable and useful book. It is full of ideas, analyses, and statistics. It will be kept at hand for ready reference and rereading by most persons concerned with labor force analyses.

Gladys K. Bowles

Economic Growth in France and Great Britain 1851-1950.

By Charles P. Kindleberger. Harvard University Press, Cambridge, Mass. 378 pages. 1964. $8.95.

The author at one point asserts he is an amateur economic historian; at another he is a critic of economic historians. Big theories, he states, do not explain economic growth; little theories frequently contradict one another. As in his earlier book, "Economic Development," he is the complete eclectic, bound to no one thesis, but threading his way instead among facts and theories in an effort to find universal truth, or at the least to throw some light on it.

The emphasis of the book is primarily on French economic development, in comparison with British experience. National income per capita in France was well below that of Britain in 1950, as it was in 1851. Why did France not catch up? The author examines the literature extensively, with its ofttimes differing interpretations. He seems to conclude that possible limitations in natural resources were not a handicap. There was really no lack of credit, but the machinery was sometimes ineffective.

The long-standing theory that the low rate of population growth in France contributed to economic stagnation is found to be elusive. French and British social behavior and beliefs are contrasted but without demonstration of economic significance. In discussion of entrepreneurship, Kindleberger gives special attention to the French family firm. A straightforward exposition of overly cautious investment policy, as illustrated in the textile industry, as a deterrent to rapid economic growth turns out to be not sufficiently subtle; the model is incomplete; what is needed is an explanation of why other firms did not come along and challenge existing enterprise.

And so it goes. Arguments and cases on one side are counterbalanced by arguments and cases on the other. Attention is given to technology, scale and competition, government, urbanization and regional balance, foreign trade, leading sectors, the nature of growth, and even a search for a method. But causation in the real world is too complex and interrelated; in the end the author despairs of solving scientific problems by the historical approach.

There is a chapter on agricultural transformation of special interest to readers of this journal. Various ways in which an increase in agricultural productivity can be used to speed economic development are recognized. Four views on this matter are selected by Kindleberger: that agriculture held back the total growth of France by growing at a slower rate than industry; that agriculture held back French development through failing to produce sufficient demand for industrial products; that agriculture failed to release sufficient manpower to industry; and that, on the contrary, industry drew men too fast from agriculture, thereby reducing its productivity.

On the first view, it is concluded, somewhat equivocally, that if French agriculture as a whole has been held down by the backwardness of its small-scale farms, French economic growth as a whole has been held back by the slowness of advance in agriculture. On the second view, there appears to be a more positive finding that loss of agricultural income was a factor contributing to the prolonged period of

economic stagnation in France after 1882, but only in combination with other factors--the end of railroad expansion, stock market excesses, and a halt to the building boom. Negative answers are given to the third and fourth hypotheses.

On British agriculture, the author deplores the failure of farmers to shift to a livestock economy, particularly to dairying, when the demand for livestock products was so strong and the price of wheat was so weak for so long.

One admires the book in its entirety for its serious and profound scholarship, but somewhat regrets its scarcity of conclusions. But perhaps the real world is too complex to see it whole after all.

Robert M. Walsh

Agriculture in Western Europe.

By Michael Tracy. Frederick A. Praeger, Publisher, New York. 409 pages. 1964. $10.

FARM POLICY occupies the center of the stage within the European Common Market countries, and in their position toward outside countries. It is obvious that a major part of the negotiations for the final effectiveness of the European Economic Community will be determined by how successfully farm policy questions are resolved. This is not only an internal matter with the EEC but it is highly important as regards the Kennedy Round of the worldwide tariff and trade negotiations.

Officials responsible for the EEC and for international negotiations need an understanding and appreciation of the current agricultural policies of the individual nations concerned. This book in a major sense fulfills this need for certain of the European countries, including the United Kingdom. To know and appreciate present farm policy one must understand how it was originally evolved, how it has been nurtured, modified, and adapted to what were the apparent pressures of the moment. The author, an economist with the Agriculture Division of the Organization for Economic Cooperation and Development, Paris, outlines the historical foundation of agricultural policies by dividing its aspects into three periods: (1) 1880-1900--the first wave of protectionism; (2) the crisis of the 1930's--the second wave of protectionism; and (3) since the Second World War--State involvement in agriculture.

These periods have particular meaning for the countries under study; that is, for the United Kingdom, France, Germany, and Denmark. Contrasting pictures of policy development are presented, indicating that Denmark and the United Kingdom adapted more or less to industrializing and urbanizing economies and to the exigencies of foreign trade; while the policies of Germany and France veered toward protecting agriculture and preventing its adaptation to changing technology and changing terms of trade relationships within domestic as well as within international economies. These countries were studied in detail, but not exclusively, as references to other nations' policies have been made when needed for comparative purposes. The conclusion for policy arrived at by the author is that both laissez-faire and protectionism have failed--that each approach has prevented necessary structural adaptation and solutions to low incomes in agriculture.

This book is well organized and in this reviewer's opinion well documented. Its title could be misleading in that one might think it to be a work on agricultural production. The extensive bibliography is not devoted solely to the countries given detailed study, but includes pertinent materials for other Western European nations as well. Students of policy and those dealing with trade negotiations will want to study and make use of this volume.

John H. Southern

Low Incomes in Agriculture--Problems and Policies.

Organization for Economic Cooperation and Development. OECD Publications, Paris. 515 pages. 1964.

IT IS DIFFICULT to describe the low-income farm problem in the United States. With differences in historical patterns, currency, available data and goals, it is more difficult

to summarize low-income problems of the 22 OECD countries. U.S. data are limited, but most other nations, except Canada, the Netherlands, and the United Kingdom, have practically no income data for small farms or for nonfarm and family income. Thus definitions of low-income farms are arbitrary, with each country using a different standard.

The report outlines problems of low-income farms in the 22 OECD countries and reviews measures used or proposed to deal with them. These measures include supports for prices and incomes, improved efficiency on farms, changes in external farm structure, and development of alternative nonfarm employment opportunities.

All the cooperating nations want to develop viable farms that contribute to economic growth. There is a passing statement that a healthy economy is necessary to provide improved incomes for farmers and to transfer resources out of agriculture. But low-income farms have long been ignored in farm policies of most nations, including the United States. Policies to help low-income farms are new and have limited effect. All governments support prices of one or more farm products with income assistance related to sales. A few give a higher price to small farms on limited marketings, with little effect on income. The United Kingdom deliberately does nothing for small farms, but encourages farmers to leave agriculture or to consolidate holdings.

All countries with a fragmentation problem try to encourage a more rational landholding pattern, usually purchasing land for resale and granting long-term credit. Most countries try to enlarge landholdings, but limit the size of new holdings. The policy limits the potential for developing viable units, since a farm of a given size becomes a smaller economic unit as new technology is adopted. But no country increases the limits on size to keep up with technology or permit organization of extensive farming units in poor land areas.

It is revealing to contrast the policies of the Netherlands and West Germany with their booming economies. Both are reducing the number of farms and farm population.

The Netherlands wants to move labor resources out of agriculture. The government encourages larger farms by purchasing land, guaranteeing loans, and giving premiums to discontinue nonviable holdings. Farm youth are trained for nonfarm jobs. Employment opportunities are created outside farming by encouraging industry to locate in 15 centers in less developed areas, principally by improving the infrastructure, especially transportation facilities. But resources might be concentrated more effectively in fewer centers. There is concern that a labor shortage might occur if industrial opportunities increase too rapidly, but more part-time farming would enlarge the nonfarm work force. The integrated policies show concrete results and considerable promise.

Policies in West Germany do not take advantage of the high levels of industrial activity to improve incomes of small farms. Farms are consolidated and enlarged, but the average farm is enlarged only 2 hectares. The government encourages new industry in rural areas. Yet West Germany keeps population on farms, since only part-time farmers receive vocational training and education of youth in many areas is deficient. No steps are taken to move farm people into nonfarm jobs to facilitate enlargements of landholdings when 1 million foreign workers are imported. Yet, farmers are moving into industries in spite of present policies.

Countries where agriculture is a dominant industry--Turkey, Greece, Spain, and Portugal--have greater problems. The need for education and investment is recognized, but tremendous resources are needed to deal with the problems. With widespread low incomes, extreme measures and outside capital will be needed in these countries to improve productivity of agriculture, develop nonfarm employment, and check population growth.

Within the limits of available data, this work describes the conditions, problems, objectives, and policies on low-income farms of the reporting nations. It is an excellent summary that should be read by those concerned with agricultural policy and resource development.

Melvin R. Janssen

Cattle Raising on the Plains, 1900-1961.

By John T. Schlebecker. University of Nebraska Press, Lincoln. 323 pages. 1963. $6.

ECONOMISTS, both in the Department of Agriculture and in the colleges and universities, have given much attention to cattle and beef and to programs affecting their prices during the past year. The United States signed agreements with Australia and New Zealand to limit the amount of beef shipped to the United States. Congress stated that its policy was to limit beef and other meat imports to specified quantities. The Department of Agriculture increased its purchases of beef and took other steps to bolster prices.

The problems which afflicted cattle producers last year did not arise in a vacuum. As John T. Schlebecker of Iowa State University says: "The contrast between the cattle of 1960 and of 1900 was so marked as to be nearly unbelievable. Whatever could be said for the rest of mankind, progress clearly characterized the history of the Great Plains." This is the story of that change and progress.

Year by year, cattlemen applied science and technology to their business, and so produced more beef on less land, with less work, and at less hazard to themselves. Professor Schlebecker, who taught at the University of Montana and Montana State College before going to Iowa State, traces these changes in chronological chapters, covering 4 or 5 years in each. This sometimes means that an account of a particular technological advance is spread over several chapters.

Three themes run through the volume. First, the successful cattlemen on the Great Plains were those who constantly made changes in every aspect of the business. Second, the application of science and technology to cattle raising was a key to progress. Third, the Great Plains cattlemen demanded and received much help from the Federal Government.

The first and most important change the cattlemen made was the shift from the open range to the controlled range or ranch. The open range industry supplied an uncertain quantity of meat of rather inferior quality. The controlled range permitted the farmer to produce better meat through the application of science and technology.

The control of breeding and feeding was the first step in the new technology. Then came disease and pest control, better transportation, better land use, and other changes, culminating in advances in biochemistry. Most of these advances were possible through assistance by the Federal Government.

The Great Plains livestock industry has depended, since its beginning, upon Federal land. During the 19th century, use of the land was free and uncontrolled. Today, most of the Federal lands are controlled. The various controls have been developed by the Congress and the Federal agencies concerned, in cooperation with the livestock associations.

Virtually every scientific advance has come as the result of Federally sponsored research, either in the Department of Agriculture or in the State experiment stations. Most of these research programs have been strongly urged by ranchers and their associations. Too, Professor Schlebecker points out, the livestock groups have asked for many actions to help maintain cattle prices.

This volume is particularly recommended to livestock economists, land use specialists, and scientists who are concerned with how the Great Plains livestock industry arrived at the place in which it is today.

Wayne D. Rasmussen

Selected Recent Research Publications in Agricultural Economics Issued by the U.S. Department of Agriculture and Cooperatively by the State Universities and Colleges [1]

Barker, Randolph. USE OF LINEAR PROGRAMMING IN MAKING FARM MANAGEMENT DECISIONS. Cornell Univ. Agr. Expt. Sta., Ithaca, N.Y., Bul. 993, 42 pp., April 1964. (Econ. Res. Serv. cooperating.)

Describes the application of linear programming on two individual farms in New York State. A brief description of each farm is followed by a discussion of the problems considered and the solutions obtained. Further details relative to the construction of the models and selection of appropriate data are presented in appendixes.

Bird, Alan R. POVERTY IN RURAL AREAS OF THE UNITED STATES. U.S. Dept. Agr., Agr. Econ. Rpt. 63, 46 pp., November 1964.

In 1959, approximately 17.4 million rural people were living in poverty (families with incomes less than $3,000 or individuals with incomes less than $1,500). If poverty is to be reduced, two general types of programs seem to be needed. These are programs to raise the economic status of families and programs to develop, consolidate, or otherwise upgrade public services such as schools, hospitals, roads, and water supplies.

Bohall, Robert W., Raymond O. P. Farrish, and Joseph C. Podany. PACKING MATURE GREEN TOMATOES: COSTS, EFFICIENCIES, AND ECONOMIES OF SCALE IN THE LOWER RIO GRANDE VALLEY OF TEXAS. U.S. Dept. Agr., Mktg. Res. Rpt. 679, 45 pp., November 1964.

Packers of mature green tomatoes from the Lower Rio Grande Valley could achieve considerable savings by operating a longer season and shifting to larger capacity packing sheds. A 40-pound package was found to cost $1.17 in a small model shed operating a 100-hour season, 91 cents in a 200-hour season, and 82 cents in a 300-hour season. Comparable costs for a large shed were $1 for 100 hours, 80 cents for 200 hours, and 74 cents for 300 hours.

Boxley, Robert F., Jr. OWNER CHARACTERISTICS AND DISTRIBUTION OF LANDOWNERSHIP IN THE EASTERN GREAT PLAINS. U.S. Dept. Agr., Econ. Res. Serv., ERS-197, 26 pp., November 1964.

Individual landholdings in three specialized farming regions of the Great Plains range in size from small tracts to units of thousands of acres. The three regions were studied, and the report describes relations found between size of landholding and method by which land was acquired, age of owner at acquisition, length of ownership, and owner occupation.

Carley, D. H., and T. L. Cryer. FLEXIBILITY OF OPERATION IN DAIRY MANUFACTURING PLANTS: CHANGES 1944 TO 1961. U.S. Dept. Agr., Agr. Econ. Rpt. 61, 44 pp., October 1964.

From 1944 to 1961, numbers of plants manufacturing dairy products decreased from 9,739 to 6,134 but the average number of products manufactured per plant increased from 1.5 to 2. Condensed milk, nonfat dry milk solids, frozen-product mixes, and frozen products were most often produced in multiple-product plants. Cheese and evaporated milk were produced more often in single-product plants.

Cockroft, Lindon U., and J. W. H. Brown. DEVELOPING AND MARKET TESTING AN IMPROVED LOOSELEAF TOBACCO PACKAGE. U.S. Dept. Agr., Econ. Res. Serv., ERS-189, 10 pp., September 1964.

A new packaging method for flue-cured tobacco that might save growers millions of dollars a year is described. Key features of the method are use of a wooden frame during packing and a knitted paper sheet to wrap the tobacco, resulting in a square package of loose leaves. The package prevents tangling and breaking of the leaves as the tobacco moves through auction rooms and on to processing plants.

Davis, Jeanne M. NEW ENGLAND FARM VACATION BUSINESSES: CHARACTERISTICS AND OWNERS' EXPERIENCES. U.S. Dept. Agr., Agr. Econ. Rpt. 60, 20 pp., October 1964.

Owners of about 50 vacation farms in 4 New England States were interviewed. The owners listed among the advantages those of meeting interesting people and helping city people learn about farm life, as well as earning additional cash income. The disadvantages include adverse weather, lack of privacy, and the fact that income may be low.

Guidry, Nelson P. A GRAPHIC SUMMARY OF WORLD AGRICULTURE. U.S. Dept. Agr., Misc. Pub. 705, 64 pp., September 1964.

Contains maps and charts showing the geographical distribution of agricultural production and trade, world population, and such physical factors as land

[1] State publications may be obtained from the issuing agencies of the respective States.

forms, annual rainfall, soils, and vegetation. Also shown graphically are variations in food consumption throughout the world and the relation between regional food supplies and requirements.

Holm, Henrietta M. ISRAEL'S AGRICULTURAL ECONOMY IN BRIEF. U.S. Dept. Agr., Econ. Res. Serv., ERS-Foreign-96, 8 pp., September 1964.

In the first 12 years of Israel's statehood, its index of farm production increased from the 1948/49 base (100) to 489. Agriculture has rarely contributed more than about 12 percent of the national income or employed more than an average of 17 percent of the labor force. Improved production techniques have reduced the number of farmers required to sustain and reasonably increase farm production.

Holm, Henrietta M. TURKEY'S AGRICULTURAL ECONOMY IN BRIEF. U.S. Dept. Agr., Econ. Serv., ERS-Foreign-97, 8 pp., September 1964.

The economy of the Republic of Turkey is predominantly agricultural. Although there is an increasing trend toward urbanization, less than a third of the population lives in towns and cities. About four-fifths of all Turkish exports, by value, are of farm commodities.

Jones, W. Webster. ECONOMICS OF MILK MARKETING IN ALASKA. U.S. Dept. Agr., Mktg. Res. Rpt. 675, 34 pp., September 1964.

Since 1957 sales of fresh milk have declined almost 14 percent in four Alaskan markets. The decline was largely the result of increases in differences among consumer prices of fresh milk and its substitutes--nonfat dry milk, concentrated milk, and evaporated milk. Additional lower-priced substitutes have been introduced in some of the markets.

Kriesberg, Martin. FOOD SERVICE IN PRIVATE ELEMENTARY AND SECONDARY SCHOOLS. U.S. Dept. Agr., Mktg. Res. Rpt. 678, 21 pp., October 1964.

Cash receipts for food served in the Nation's private schools were about $9 million during March 1962, or $75 million for the school year. About $60 million worth of the food used in the 1962-63 school year was purchased locally through regular commercial channels; the rest was donated by the Federal Government. About 5,000 private elementary and secondary schools served complete plate lunches under the National School Lunch Program. Another 1,500 schools had other food services.

Kriesberg, Martin. FOOD SERVICE IN PUBLIC SCHOOLS. U.S. Dept. Agr., Mktg. Res. Rpt. 681, 39 pp., November 1964.

About two-thirds of the Nation's 97,000 public elementary and secondary schools participated in the National School Lunch Program in March 1962. Another 4,300 public schools also served lunches. Cash receipts from the sale of lunches to pupils in public schools totaled an estimated $900 million in 1962.

Larsen, Marion R. THE AGRICULTURAL SITUATION AND CROP PROSPECTS IN COMMUNIST CHINA, 1964. U.S. Dept. Agr., Foreign Agr. Econ. Rpt. 20, 10 pp., October 1964.

Diets in Communist China are improving but both the quantity and quality remain much below the level of 1957. The report examines three broad aspects of Chinese agriculture; weather, crops, and food availability. Effects of additional inputs, new approaches, and the vagaries of weather on the outlook for Chinese agriculture are discussed.

McConnell, Robert M. A SURVEY OF AGRICULTURE IN MALAYSIA. U.S. Dept. Agr., Econ. Res. Serv., ERS-Foreign-95, 55 pp., October 1964.

Agriculture forms the basis of the economy in all areas of Malaysia except Singapore. However, raw and semiprocessed agricultural commodities constitute a large portion of Singapore's trade. The production of rubber is of paramount importance throughout the entire area.

Metzler, William H. THE FARM WORKER IN A CHANGING AGRICULTURE. Calif. Agr. Expt. Sta., Giannini Found. Res. Rpt. 277, 98 pp., September 1964. (Econ. Res. Serv. cooperating.)

First of a projected series of three reports on the impacts of technological change upon demand for farm labor. The study is centered in Kern County, Calif., one of the Nation's most productive farming areas.

Moncure, Robert C. SOUTH AFRICA'S AGRICULTURAL ECONOMY IN BRIEF. U.S. Dept. Agr., Econ. Res. Serv., ERS-Foreign-103, 8 pp., November 1964.

The Republic of South Africa has a rather highly developed agricultural research organization and expanding modern education, extension, and conservation services. The general economic situation was prosperous for the Republic in 1963 and 1964. Manufacturing now contributes a higher percentage of the Republic's gross national product than agriculture.

Powell, Jules V. THE DOMESTIC TREE NUT INDUSTRIES: AN ECONOMIC APPRAISAL. U.S. Dept. Agr., Agr. Econ. Rpt. 62, 41 pp., November 1964.

Brings together information concerning the production and marketing of major domestic tree nuts--almonds, filberts, pecans, and walnuts. The growth of the tree nut industries has been rapid since the early 1900's. Marketing of almonds, filberts, and walnuts is regulated by Federal marketing agreements and orders.

Pritchard, D. L. SPOT COTTON QUOTATIONS: THEIR RELATION TO SPOT VALUES AND TO AVERAGE DIFFERENTIALS. U.S. Dept. Agr., Mktg. Res. Rpt. 677, 38 pp., October 1964.

Spot cotton prices are compared with the official quotations issued by each of the designated spot markets during the seasons of 1959-60 and 1960-61. Price differentials from Middling 1-inch cotton are compared with quoted differentials within each season and for both seasons. Although quotations were found to differ from prices paid for individual qualities at a particular time, the discrepancies tended to be offset when all qualities were considered for a long period.

Pritchard, Norris T. THE FEDERAL RAISIN MARKETING ORDER. U.S. Dept. Agr., Econ. Res. Serv., ERS-198, 22 pp., October 1964.

Emphasizes some immed and practical courses of action the California raisin industry might take to improve its economic position, using the tools provided by the Federal Raisin Marketing Order. Some problems that can be alleviated by industry actions within the framework of the Order include reducing price and market instability and expanding total raisin production and sales.

Rollag, Norman L., and Robert V. Enochian. THE FREEZING OF COMMERCIAL BAKERY PRODUCTS: CURRENT PRACTICES, PROBLEMS, AND PROSPECTS. U.S. Dept. Agr., Mktg. Res. Rpt. 674, 41 pp., September 1964.

Nearly 40 percent of bakers interviewed in 28 cities froze part of their production in 1962. Most of the bakers interviewed used freezing to achieve economies by baking more than a day's supply of low-volume items and freezing the excess for later sale. Retail bakers used freezing more often than wholesale or grocery chain bakers.

Singleton, Carey B., Jr. THE AGRICULTURAL ECONOMY OF TANGANYIKA. U.S. Dept. Agr., Econ. Res. Serv., ERS-Foreign-92, 59 pp., September 1964.

The United Republic of Tanganyika and Zanzibar may become an increasingly significant market for U.S. farm and nonfarm products. The United States is the third best customer for the Republic, with the United Kingdom first and West Germany in second place for imports and exports. Coffee is the primary product shipped to the United States.

Skinner, Snider W. NIGERIA'S AGRICULTURAL ECONOMY IN BRIEF. U.S. Dept. Agr., Econ. Res. Serv., ERS-Foreign-98, 8 pp., September 1964.

About half of Nigeria's national income is derived from agriculture. Nigeria has a prosperous and active economy and almost all economic indicators point to sustained expansion and growth. But managerial and technical skills are needed; transportation is barely adequate; electric power supply is insufficiently developed; and land clearing is costly.

Sundquist, W. B., and James Holt. INCOME-IMPROVING ADJUSTMENT ALTERNATIVES ON GRADE A DAIRY FARMS IN MINNESOTA. Univ. Minn. Agr. Expt. Sta. Bul. 473, 28 pp., 1964. (Econ. Res. Serv. cooperating.)

The study's purpose was to determine how Minnesota grade A dairy farms might be expanded or reorganized using resources typically available to farmers. It was assumed that quantities of some resources could be expanded with credit. The "most profitable" farm organizations presented are not established farms but are estimates of how farm resources could be used to maximize farm income.

Vermeer, James, and Ronald O. Aines. THE PILOT CROPLAND CONVERSION PROGRAM: ACCOMPLISHMENTS IN ITS FIRST YEAR, 1963. U.S. Dept. Agr., Agr. Econ. Rpt. 64, 47 pp., November 1964.

Five areas under the 1963 Pilot Cropland Conversion Program were studied. In each of the areas studied, farms in the program were larger and the size increased more from 1962 to 1963 than other farms in their respective counties. Payments for conversion ranged from $8 for the poorest land in the program in North Dakota to $70 an acre for the best land in the program in Iowa.

U.S. Department of Agriculture. HANDBOOK OF AGRICULTURAL CHARTS, 1964. Agr. Handbook 275, 164 pp., September 1964.

Contains information on the overall agricultural economic situation, farm commodities, foreign agricultural trade, marketing, farm population, and family living. The book has 158 charts, most of them accompanied by tables of detailed data updated where possible into 1964.

U.S. Department of Agriculture. SPREADS IN FARM-RETAIL PRICES OF WHITE BREAD. Misc. Pub. 969, 15 pp., September 1964.

Shows changes in bread prices, spreads, and costs from 1947-49 through 1963. Supersedes "Marketing Margins for White Bread," Misc. Pub. 712, revised November 1962.

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